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SAMPLING ACTIVITIES REPORT

FOR

COLUMBINE LANDFILL
COD 980951735
ERIE, WELD COUNTY
COLORADO

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1.0 INTRODUCTION

This report is submitted as partial fulfillment of a cooperative agreement between the Colorado Department of Health, Hazardous Materials and Waste Management Division (CDH) and the U.S. Environmental Protection Agency, Region VIII (EPA). The investigation was undertaken to satisfy, in part, the evaluation of environmental and health impacts that the Columbine Landfill and adjacent properties present to the people and commerce of the State of Colorado, and continuation of the CDH cooperation with the EPA in pre-remedial actions.

The sampling plan dated October 31, 1990 (revised December 7, 1990) was submitted to EPA and approved. The CDH sampling team included Austin Buckingham (Project Officer), Steve Gunderson (Site Safety Officer) and Glenn Mallory (Sampler). Background monitoring wells were drilled on February 26, 27 and March 1, 1991. Sampling at the site was conducted in two phases. Phase I sampling was conducted on March 19, 1991 under case number 16040. Phase II sampling was conducted on April 18, 1991 under case number 16256. Samples were submitted for volatile organic compound (VOC) analysis, base/neutral acid/ extractable (BNA) analysis, regular analytical services (RAS) inorganics and RAS PCB/pesticides. Organic fraction samples for case numbers 16040 and 16256 were shipped to S-Cubed Laboratories in San Diego, California and Wadsworth/Alert Laboratories, Inc. in North Canton, Ohio; respectively. Inorganic fraction samples for case numbers 16040 and 16256 were shipped to Associated Laboratories, Inc. in Orange, California and Datachem, Inc. in Salt Lake City, Utah; respectively. All samples were delivered under the proper chain of custody and analyzed within the required holding times (with exceptions as noted in Section 5.0 of this document).

2.0 OBJECTIVES

The CDH identified seven primary objectives in the site sampling plan:

* Selected on-site monitoring wells will be sampled and analyzed for the target compound list.

* Selected Laramie/Fox Hills Aquifer wells will be sampled and analyzed for the target compound list.

* Surface water and soil samples from pond #1 and pond #4 in the south draw will sampled and analyzed for the target compound list.

* Background wells will be drilled and a representative sample will be collected and analyzed for the target compound list and background water quality.

* Possible releases of site contaminants to the alluvial and bedrock aquifers will be documented through sample collection at domestic wells, landfill monitoring wells and background water monitoring wells.

* Potential human target population impacts will be evaluated for each migration pathway.

* Sensitive environments within the appropriate target distance from the site will be identified.

3.0 BACKGROUND

3.1 Site Location

The landfill site (see figure 1 & 2) is located approximately 1 1/4 miles southeast of the town of Erie in Weld County, Colorado. The Columbine Landfill site (now known as Laidlaw South) occupies 160 acres in the E 1/2 NW 1/4 and W 1/2 NE 1/4 of Section 29, Township 1 North, Range 68 West. The Old Erie Landfill site (aka the Pratt property) occupies 35 acres in the NE 1/4 NE 1/4 of Section 29, Township 1 North, Range 68 West. The Laidlaw North site (previously known as the Horst Landfill) occupies 80 acre in the S

1/2 SW 1/4 of Section 20, Township 1 North, Range 68 West. The approximate site coordinates are latitude 40 01' 40" and longitude 105 01' 15". To reach the site from I-25, take the Erie exit, go west to Weld County Road #5 and go south one mile. The entrance to the site is at the intersection of Weld County Road #5 and #6. The site address is 1441 Weld County Road, Erie, Colorado 80516.

3.2 Site Description

The three landfill sites (the Pratt property, the Laidlaw North Property and the Laidlaw South property) lie on gentle western sloping topography with approximately 1 to 5% gradient. Portions of the Laidlaw South property and much of the Pratt property lie within the middle draw. The Laidlaw North property, though currently active, is partially closed and will be fully closed within approximately 2 years. The Laidlaw South property has intermediate cover on some areas but continues to be actively landfilled. Landfilling is planned for the Laidlaw South site for, as of yet, an undetermined length of time. The Pratt property stopped receiving waste in 1979 and was properly closed and revegetated in 1984. The entire site (inclusive of the three subject properties) is fenced and access is restricted with the exception of the eastern most segment of the Pratt property.

It should be noted here that the three subject sites are being evaluated together in this report. At this time, there is limited ground water monitoring at the perimeter boundary of the three sites. Ground water monitoring that could distinguish contaminant contribution between the three sites is not present. Further, due to the topographic relief at the site and the tendency for the alluvial ground water to follow that topography, ground water contamination that may exist on the Pratt property will flow westward toward the Laidlaw South property (aka Columbine Landfill). This report intends to describe, and evaluate monitoring points and data within the framework of the three sites operating as a single entity.

3.3 Previous Work

A Preliminary Assessment (PA) of the Columbine Landfill was performed by CDH in June 1984. The PA stated that approximately 1500 drums containing 84,000 gallons of liquid were disposed on the Pratt property. The waste was generated by IBM between 1965 and 1969. The nature of the liquid wastes were suspected as solvents, unspecified organics, inorganics, acids and bases. Contamination to the shallow alluvial ground water was listed as a potential but undocumented at the time of the PA.

A Site Investigation report (SI), performed by CDH in June 1984, summarized the site history and geology. Surface water and ground water samples were collected and analyzed for the EPA target compound list. Several compounds were detected in the SI samples but many were discounted either because they were suspected laboratory contaminants or because the compounds were exotic and only tentatively identified. However, two compounds identified as being present in the ground water were 1-Butene and Oxybismethane. The compounds were found at levels of 130 micrograms per liter (ug/l) for 1-Butene in GW-1, 310 ug/l for Oxybismethane in GW-1 and 370 ug/l for Oxybismethane in GW-8 (aka GW-2 in the SI). The SI report concluded that:

1.) The landfill is producing leachate based on the specific conductivity;
2.) That some mounding may be occurring thus allowing leachate to migrate offsite and up gradient; and
3.) That further follow-up work is needed to accurately determine the presence of the organic constituents.

The CDH conducted another Preliminary Assessment in November 1990. The CDH maintains files on the three landfill sites designated above which were summarized in the 1990 PA. The major environmental pathway of concern identified in the 1990 PA is the ground water pathway with possible contamination to the alluvial aquifer, the shallow bedrock aquifer and a spring located in the south draw.

3.4 Site History

There have been various land uses and transfers of ownership on the parcels of land located in Section 20 and 29, T1N, R68W. The parcel owned by Pratt has been in the family since 1912. Due to the topographic relief of the draw on site, it was unavailable for farming. To correct this problem the Pratt's entered into an agreement with Mr. John F. Neuhauser in 1964 to fill in the drainage in the NE 1/4 NE 1/4 Section 29, T1N, R68W, the intent being; creating a relatively level land surface so that it could eventually be farmed. Neuhauser with Mr. Carl Smith (both employed by Sundstrand Aviation) formed a company called Sanitation Engineering, Inc. They hauled solid waste from nearby communities. [Record keeping during the late 1960's until the late 1970's was very poor. Much of the following discussion is based on interviews.] Sanitation Engineering had apparently obtained a contract with I.B.M.-Boulder and Sundstrand Aviation to dispose of a portion of their waste stream. The landfill, which may have been known as the Erie Landfill, accepted industrial and chemical wastes in addition to regular municipal solid wastes. The site was not fenced and was a continual source of complaints from the landowner.

IBM reported to the EPA an estimate of the amount and type of waste they had disposed of at the Erie Landfill between 1965 to June 1969. In the EPA Notification (shown in figure 3) IBM estimated that 84,000 gallons of chemical waste contained in 1500 55 gallon drums were disposed. The chemical waste types were organics, inorganics, solvents, acids and bases. The chemicals typical of IBM manufacturing include No. 1, No. 2 and No. 6 fuel oil, liquid nitrogen, methyl ethyl ketone, trichlorofluoroethanol, 1,1,1-trichloroethane, toluene, tetrahydrofuran, methylene chloride, n-butylamine, ethylene diamine, ammonia and sulfuric acid.

The earliest document on file regarding the Neuhauser site is dated August 9, 1966. A routine Boulder County inspection noted that two pits were dug for the disposition of some chemicals. In a third pit, it appeared that chemicals were being burned. Mr. Neuhauser reported that Sundstrand brought torpedo propellant to the site in tanker trucks. The specific propellant type is unknown; however CDH chemists have suggested that it may have be a diethylene glycol dinitrate or perhaps a non-symmetrical dimethyl hydrazine. The propellant was pumped from the tanker into a pit lined with a metal container. The pit was then ignited to dispose of the propellant. On September 29, 1966 an inspection was performed by a CDH representative. The report noted that chemical wastes were being discharged in designated areas. Cover material being supplied from an excavation designed to divert natural drainage around refuse fill rather than through the fill was noted in the same inspection. Mr. Neuhauser commented, at the time of the inspection, that operational improvements were delayed pending the outcome of the recent court decision. This court decision that he may be referring is the Public Utilities Commission (PUC) hearing regarding poor disposal practices at the old Erie Landfill. It is known, via IBM conversations, that Neuhauser was brought before the PUC for his disposal operations. A transcript of this hearing seems to be unavailable. IBM does not have a copy of the transcript and the PUC purges their documents every two years. The exact date of the hearing is unknown. However, as a result of the PUC decision, IBM terminated their contract for disposal with Neuhauser in June 1969.

On July 17, 1968,a Certificate of Designation (CD) was issued to John F. Neuhauser by the Weld Board of County Commissioners for the Erie Landfill. An Air Pollution Control Division memo dated July 31, 1968 stated that an uncontrolled chemical fire occurred on July 26, 1968 at the Neuhauser dump located just inside Weld County in the southwestern corner. Approximately 3000 gallons of waste chemicals had burned. Adjacent to the area, where the chemical fire occurred, was an open burning dump face that appeared to have been burning for quite some time. During conversations at the time of the incident, Mr. Neuhauser revealed that the waste chemicals were from the IBM plant in Boulder County and the Sundstrand Manufacturing complex in Adams County. The site inspector recalled that Mr. Neuhauser had at one time operated a dump site in Boulder County but was closed down for contaminating ground water and operating an uncontrolled dump. On October 30, 1968 the CD was suspended by Weld County for 33 days; but was held in abeyance for a 6 month probation period. Mr. Neuhauser sold his share of Sanitation Engineering to his partner Carl Smith in late 1968.

There is no information found regarding activities at the Erie Landfill between 1969 and 1973. By this time Weld County had all of the county landfills contracted out to a single operator. According to Mrs. Barbara Roweder, Ralph Roweder (her husband) worked for BFI as supervisor for the Weld County Landfills, starting sometime around 1973/1974. BFI probably operated the Erie Landfill and perhaps all of the Weld County Landfills prior to Ralph's employment.

During the mid to late 70's, CDH inspected the landfill several times. A CDH inspection dated 06/02/75 states oil-water waste should be sprayed onto or worked into the existing landfill face. Two CDH inspections in February and April 1976 stated that approximately 1500 gallons per week of oil and water waste was deposited at the base of the landfill. In October 1976, Ralph Roweder purchased BFI's contract to operate the Weld County Landfills. In a memo from the Dacono Fire Department (dated February 7, 1978), the Fire Chief expressed his concern with the frequent fires at the Erie Landfill requiring 10,000 to 100,000 gallons of water to extinguish. No other information was discovered regarding site operations until January 1979 when Ralph Roweder died. Mrs. Barbara Roweder prepared to sell the contract to operate the Weld County Landfills. Lynn Kiernes (owner of Colorado Landfill, Inc.) purchased the contract sometime in 1979.

The Weld County Commissioners revoked by resolution the Erie Landfill CD on June 6, 1979. Colorado Landfill, Inc. was not interested in operating the old Erie Landfill site, therefore the abandoned Erie Landfill was not properly closed. Mr. Lynn Kiernes decided to purchase the Columbine Mine site immediately west of the Old Erie Landfill and operate it as a sanitary landfill. The Rocky Mountain Fuel Company owned both the surface and mineral rights of the 160 acres within E 1/2 NW 1/4 and W 1/2 NE 1/4 Section 29, T1N, R68W. This area was known as the Columbine Mine No. 1 which operated from 1920-1946. In the subsurface, the mine occupied nearly all of Section 29 and much of the south half of Section 20. In June 1979, the surface rights were sold to Colorado Landfill, Inc. while Rocky Mountain Fuel retained the mineral rights.

Colorado Landfill, Inc. applied for and received in 1979 a Certificate of Designation to operate a sanitary landfill (authorized to accept municipal solid wastes only) on the Columbine Mine site. The landfill was called the Columbine Landfill. The Kiernes planned for continued disposal into the draw that ran from east to west across the site. The new operations plan called for a 6" scarified/recompacted clay liner and a ground water monitoring plan.

A CDH inspection of the Columbine Landfill dated 11/17/81 stated that oil and grease was within the soil at the northeast end of the site and ponded sludge was found. Approximately 500 gallons per week of car wash and grease trap wastes were disposed of at the site. In a 09/27/82 inspection, 6000-9000 gpd of sand and grease trap waste sludges (at 1% solids) were being spread at the landfill site for 6-8 weeks. In 09/01/82, the Colorado Landfill, Inc. requested permission to fill and cover the old Erie Landfill due to serious erosion and exposure of wastes. The request was granted by Weld County on May 4, 1983. In May 24, 1983, a CDH memo stated that an independent laboratory found sand trap wastes disposed at the Columbine Landfill to be cyanide bearing and containing potentially EP toxic concentrations of metals. The old fill area (the Erie Landfill) had exposed trash as stated in 07/28/83 inspection. The Weld County Sheriff's Office conducted an investigation into the alleged disposal activities at the Old Erie Landfill on 09/29/83. The research turned up several polaroids (dated 12/27/68 and 02/06/69) depicting black colored 55 gallon drums. Some of the drums had the tops bulging and burning. Other drums (that were not burning) had bulging tops from apparent internal pressure. A few of the black drums had the word "PROTEX" stenciled on the sides. Discharge off-site from the Columbine Landfill was observed from a pond at the west end of the site in a May 25, 1985 inspection. The dark to black liquid discharge had a pH of 5.8 and a field conductivity of 2100 umhos.

On December 3, 1985, Columbine Landfill was purchased by Western Disposal. A new operations plan was developed which included closing the old Erie Landfill site. Laidlaw Waste Systems, Inc. purchased the Columbine Landfill in January 1988 from Western Disposal, Inc. The property became know as Laidlaw South. Laidlaw developed a closure and post-closure maintenance plan for the old Erie Landfill which was finally implemented. By this time the draw through the Laidlaw South landfill site had been completely filled.

Daniel Horst (of Landfill Systems) developed an operations plan to site a landfill to the north of the Columbine Landfill in S 1/2 SW 1/4 Section 20, T1N, R68W. The 80 acre Horst site, approved to accept only municipal solid waste, was annexed by the town of Erie on November 8, 1984. The Horst property was sold to a company called GSX on August 18, 1986. In November 1986, the GSX Corporation was purchased by Laidlaw Waste Systems, Inc. This property became known as Laidlaw North.

On the north side of the Laidlaw North property, the soil wells 103A & 103B were drilled to a depth of 20' in 12/84 and 3/88 respectively. Well 103A did not have enough water to sample until 12/87, when it found high concentrations of volatile organics. Contaminants now found in both 103A & 103B include 1,1-dichloroethane, methylene chloride, tetrachloroethene, 1,1,1-trichloroethane, chloroethane, chloroform and trichlorofluoromethane.

3.5 Geology

The site is on the northwestern flank of the Denver Basin, a large structural basin that contains important bedrock ground water resources. The Columbine Landfill Site is located within the Denver Basin, a major structural feature in the area. Structural movement which forms the present-day shape of the basin is thought to have begun at least 300 million years ago. uplift to the west formed the Ancestral rockies, a major mountain chain that existed prior to the present-day Rocky Mountains. The Ancestral Rockies were eroded and the materials were deposited in the area that is now the basin. The Fountain formation, known locally as the Red Rocks, is indirect evidence of the Ancestral Rockies. Uplift again occurred, resulting in the present-day Rocky Mountains. Subsequent erosion of the Rocky Mountains has resulted in deposition of the many sedimentary rocks found within the basin today. the present-day land surface and topography of the basin were formed by erosion of the South Platte and Arkansas Rivers and their tributaries.

The basin, which is oval in shape, is the result of racks dipping inward from all sides. The western edge of the basin is located along the frontal edge of the Rocky Mountains. The basin extends as far north as Greeley and as far south as Colorado springs. The Eastern Boundary of the basin is located approximately 80 miles east of the front range. The dip of the rocks on the western edge of the basin is relatively steep, while along the eastern edge of the basin the dip of the rocks is relatively gentle.

Potentially active faults exist in and around the Denver Area. The location of potentially active faults nearest the base are shown of figure.

The soils on the site are comprised of calcareous silt, with some clay and very fine sands. The soil deposits were formed by wind disposition, by stream deposition and by weathering of the bedrock. Soil color ranges from light brown to brownish-grey and soil thickness ranges from approximately 2 to 21 feet. Variations in soil thickness are related to irregular bedrock and land surfaces.

At the soil/bedrock interface, the bedrock is typically highly weathered with iron-stain mottling, fracturing and occasionally bearing perched water. Bedrock is exposed along the eastern edge of the Coal Creek drainage west of the site. Within the site boundaries, bedrock occurs at depths of 2 to 21 feet below the ground surface. The irregular bedrock surface somewhat parallels the surface topography and is probably produced by differential weathering of the bedrock.

The Laramie Formation, which immediately underlies the site, is typically divided into upper and lower lithologic units. The upper unit is a buff to dark-gray, organic claystone with interbedded sands. Numerous coal seams in this interval were mined in the early 1900's to provide heating coal to the cities along the Front Range. The lower unit of the Laramie Formation consists of thin to massive beds of fine-grained, moderate to well-cemented sandstone that is a buff to dark carbonaceous claystone. This lower unit has been further broken into the A and B sandstone units. The sandstones units occur at depths of 400 to 450 feet in the vicinity of the site and comprise the upper part of the Laramie-Fox Hills Aquifer.

The coals of the Laramie Formation have been extensively mined in the area by the Columbine Mine No. 1 (figure 4). Overburden thickness above the mine ranges from a minimum of 150' to a maximum of 400' with the probable extracted coal seam thickness ranging from 0' to 15'. The mine was operated by the room and pillar extraction method. After the coal seams were exhausted, the pillars were typically removed. The area has never been evaluated to determine past or future subsidence potential.

The Fox Hills Sandstone is beneath the Laramie Formation. The upper unit, the Milliken Sandstone is composed of fine to medium-grained, parallel, thick bedded sandstone, thin siltstone and shale interbeds. The unit ranges in thickness from 40 to 90 feet. The Milliken Sandstone and the overlying A and B sands of the Laramie Formation comprise the Laramie-Fox Hills Aquifer, an important source of water through out the Denver Basin. The over-lying aquifers of the Dawson Arkose, Denver and Arapahoe have been eroded away in the vicinity of the site. The Pierre Shale beneath the Fox Hills Sandstone, consists of a 7000 to 8000 foot thick sequence of gray to brown, clayey marine shales.

The site lies in a structurally complex area. Bedrock has been highly distorted through both folding and faulting, with faults that generally align in a northeasterly direction (figure 5). Surface expression of these faults is limited and there is no evidence of recent movement on any faults in the area. Regionally the bedrock dips one degree to the southeast. However, local structural deformations may cause appreciable variation.

3.6 Hydrogeology

Data published indicate that the direction of regional ground water flow in the Laramie-Fox Hills Aquifer is to the east-southeast (figure 6). Ground water is generally produced from the sandstone units at depths of 400 to 450 feet. The potentiometric surface is approximately 200 to 270 feet below land surface, indicating that the aquifer is under confined conditions.

The exploratory drilling programs have identified two shallow ground water systems at the site. The shallowest (or alluvial) ground water system is associated with the alluvial and colluvial soil materials in the topographic drainages. In a typical system, the alluvial ground water would move down the west sloping drainage, with a velocity related to the gradient, permeability and storativity of the materials. Recharge to the alluvial ground water system occurs by direct infiltration of snowmelt and rainfall from topographically elevated areas. The saturated thickness of the shallow system is generally less than 5 feet and is perched at approximately 10'-20' below the ground surface at the bedrock interface. Because the old Erie Landfill remained open essentially from 1965 to 1983, shallow ground water mounding is a possibility. If this is the case, the water table elevation could rise within the landfill therefore reversing a component of local flow from west to east. A landfill monitoring well GW7, accidentally destroyed in 1985, had approximately 7 feet of saturated waste and seemed to be evidence for possible perched conditions within the landfill mass.

The deeper ground water system found at the site is within a saturated bedrock unit consisting of siltstone, sandstone and coal units. The depth to saturated bedrock ranges from 21 to greater than 82 feet. Bedrock immediately above and below the saturated unit is dry. The lateral extent of the system is unknown but possibly occurs under much of the site. The perched ground water flow is to the northwest at a gradient of approximately 0.05 ft/ft (as stated in the Hydro Search, Inc. 1986 report). The recharge area for the shallow bedrock ground water system probably does not occur at the site as indicated by the presence of dry bedrock above this zone.

Because of the large difference in the potentiometric elevation between the local shallow bedrock ground water systems and the regional Laramie-Fox Hills Aquifer, the low hydraulic conductivity of the upper Laramie Formation claystones, and the unsaturated bedrock beneath the deeper perched system, it has been concluded that the perched and regional ground-water systems are not hydraulically connected.

3.7 Hydrology

The site is on a topographically west-facing slope with total relief across the site of approximately 155 feet. Flat areas, located between the draws, are often farmed. Two well developed drainages, with an east-west trend, cross Section 29. The drainage that bisects the Laidlaw South and Pratt landfill area is referred to here as the middle draw; the drainage to the south of the landfill is referred to as the south draw and the drainage to the north (Section 20) of the Laidlaw North Landfill is referred to as the north draw (since these drainages are unnamed).

The middle and south draw are well developed and are incised approximately 5 feet on the east end of Section 29 to as much as 20 feet farther west. Due to the depth of the drainage channel, farming was never possible across these draws. The north draw is far less developed and from old aerial photographs, farming was possible across some portions of the drainage.

The middle and south draw join just west of Section 29 in Section 30. At that confluence, the draws are bermed and water ponds behind it. Downgradient of the berm, the stream bed is dry and there is no discharge to Coal Creek. The south draw, as it runs west through Section 29, has been bermed in four places. Behind each berm, water is ponded and is supporting wetland vegetation. A seep is shown on the topographic map in the south draw. It is unknown if the middle draw was ever bermed. However, interviews with those knowledgeable of the site indicate that there were some berms with ponding behind them. The north draw is not bermed and it is generally dry except during storm events.

Coal Creek is the only perennial stream within two miles of the site. It is located approximately 1000 feet from the western site boundary and is 50 to 120 feet lower in elevation than the site. Surface water conditions in Coal Creek have been monitored upstream and downstream routinely by Laidlaw Wastes Systems, Inc. Coal Creek flow rates which have been visually estimated, range from 5 cfs to 25 cfs. Generally, the highest flows appear to occur in September and the lowest flows in January. This is somewhat inconsistent with the behavior of Front Range streams which generally have peak flows during snowmelt (April through June). This difference may be due to diversions upstream.

Total dissolved solids (TDS) in Coal Creek have ranged from about 300 to 800 milligrams per liter (mg/1). Copper, iron, manganese, and zinc concentrations are routinely at or below their detection limits of 0.01 and 0.05 mg/1. Strontium concentrations are somewhat higher (about 0.5 mg/1) Laidlaw reports that this appears to be a natural condition and does not reflect an impact from the landfill operation. Nitrate/nitrite in samples from Coal Creek have varied from about 2 to about 6.5 mg/1. Total organic carbon (TOC) concentrations have consistently been in the range of 7 to 10 mg/1. Samples were collected from Coal Creek in June 1987 for analysis of the EPA priority pollutant list. The EPA priority pollutants were not found in any of the samples.

On average, water quality is equivalent at the upstream and downstream monitoring stations. There is no indication of degraded surface water quality in Coal Creek from the landfill operation to date (table 1).

4.0 FIELD OBSERVATIONS

4.1 Non-Sampling Data Collection

A reconnaissance of the site and surrounding areas was conducted on August 8, 1990 and September 7, 1990. During these site visits, several activities were performed:

* The north, middle and south draws were observed. Any unusual conditions were noted and photographed.

* The Laidlaw North cell #7 was observed for shallow lithology.

On December 12, 1990, all utilities in the area of possible drill sites were cleared. On that same day, reconnaissance and selection of final drill sites and sample locations were performed.

4.2 Sampling Activites

Drilling at the site selected for background ground water sampling commenced on February 26, 1991 and concluded on March 1, 1991. SSI well installation, as-built well construction and development summaries are presented in Appendix A. Sample collection occurred on two days; Phase I occurred on March 19, 1991 (case no. 16040) and Phase II occurred on April 18, 1991 (case no. 16256). Sample purging and photo documentation is found in Appendix B. On March 19, 1991 the domestic use wells and landfill monitoring wells were sampled. On April 18, 1991, the background site investigation wells were sampled followed by collection of sediment samples in the south draw. Surface water samples from the south draw were not collected because the ponds have been dry since early winter and during the sceduled sample event. All SSI samples were collected in Level D protection. A total of seventeen samples were collected during the Phase I and Phase II sample events. See figure 7 and table 2 for sample locations.

4.2.1 Waste Source Samples

A possible waste source sample was collected from a landfill well known as GW1 (also known as CL-LF-GW-3) located within the Old Erie Landfill (also known asthe Pratt property). The landfill well is an upgradient bedrock well completed to a total depth of 100 feet. The purged ground water and the collected sample was extremely turbid, and had an a strong odor of decomposing wastes.

4.2.2 Ground Water Samples

Six ground water samples were collected, three from on-site landfill monitoring wells and three from domestic use Laramie-Fox Hills Aquifer wells. The ground water samples collected at these locations are shown on figure 7. Each well was purged of three well volumes. After the well's temperature, conductivity and pH had stabilized to within 10%, the sample was collected. Wells were sampled in sequence from the suspected least contaminated to the most contaminated. Proper decontamination of all non-dedicated equipment was performed as per the the Decontamination Procedures specified in the 'SAMPLING PLAN FOR THE COLUMBINE LANDFILL.'

4.2.3 Surface Water Samples

Two surface water samples were planned as part of the site investigation sample plan. Several ponds were present in the south draw during the summer and fall months prior to the sample event. As winter progressed the ponds dried up and during the sample event, ponded surface waters were no longer available for sampling.

4.2.4 Sediment Samples

Two sediment samples were collected within the dry ponds of the south draw. Sample CL-SI-SW-1 was collected as the background sediment sample from an upstream location (pond #1). CL-SI-SW-2 was collected as a possible contaminated sample from location (pond #4). All sediment samples were collected using properly decontaminated stainless steel spoons and hand augers. There was no surface water flow in the south draw area at the time of sampling.

4.2.5 Quality Control Samples

The integrity of each sample was maintained by following extensive decontamination procedures during the site investigation as described in the 'SAMPLING PLAN FOR THE COLUMBINE LANDFILL (revised December 1990),' Chapter 7, Quality Control - Quality Assurance. In addition, one rinsate blank sample, one volatile organics trip blank, one metals rinsate blank and one duplicate sample was collected. The rinsate blank was obtained by pouring organics free water over a decontaminated stainless bailer. The volatile organics trip blank was obtained by pouring organics free water directly into a volatile organics sample vial. The trip blank was prepared on the morning of the each sampling event and placed immediately into the volatile sample cooler. The metals rinsate blank was obtained by pouring metals free water through the decontaminated metals filter. The duplicate sample, CL-LF-GW-6 (GW1 DUP), was collected in exactly the same manner as CL-LF-GW-3 (GW1) and from exactly the same sample location.

4.2.6 Background Samples

Background samples collected for the investigation will be used for comparison to landfill monitoring wells and downstream sediment samples. This will aid in the establishment of observed releases as defined by the Hazard Ranking System model. Sample CL-SI-MW-1 was designated as the background alluvial ground water sample,

sample CL-SI-MW-2B was designated at the background shallow bedrock ground water sample and sample CL-SI-SO-1 was designated as the background sediment sample from the south draw.

4.2.7 Sample Containers

The sample containers used for this SSI included one-liter polyethylene bottles (metals fraction for water samples), 80-ounce amber glass jars (BNA and PCB/pesticide fraction for water samples), 40-milliliter glass vials (VOC for water matrix samples), and 8-ounce glass jars (solids samples for VOC, BNA, PCB/pesticide and metals).

4.2.8 Instrument Calibration

The HNu was calibrated in the field according to manufacturer's instructions. The specific conductance meter was calibrated daily using a 1070 micromhos per cubic centimeter standard solution. The pH meter was calibrated to pH 7 with standard solutions of pH 4 and pH 10.

4.3 Documentation

After collection, all samples were handled in strict accordance with chain-of-custody protocol described by the NEIC Procedures Manual for the Evidence Audit for Enforcement Investigations by Contractor Evidence Audit Teams, April 1984 (EPA-330/9-81-003R). Table 3 summarizes sample documentation, including sample numbers, sample tags, traffic reports, chain-of-custody and airbill numbers.

4.4 Field Observations

* A field reconnaissance identified the south draw as an area of indiscriminate dumping of waste materials. Waste materials included photoconductor material, solid wastes and empty drums (no markings visible).

* Pond #4 located within the south draw had empty drums and photoconductor material within the pond. Evidence of stressed vegetation was apparent in comparison to the other ponds within the south draw.

* The Pratt property contained landfilled wastes at the eastern terminus of the middle draw. The property has received final cover and revegetation has been successful. The property has a perimeter fence in place.

* The Laidlaw North site is partially closed. Final cover and revegetation has been reestablished on the closed portions. A limited area of alluvial ground water contamination on the north side of the site exists in the

vicinity of monitor wells 103A and 103B.

* The Laidlaw South site initially landfilled into the middle draw. A large area that has not been landfilled and therefore the site is expected to continue operation for a number of years.

* Access is restricted for all three of the subject landfill sites. Signs are posted specifying waste types acceptable to the Laidlaw facilities.

* Three drainages (with an east-west orientation) generally run parallel to each other prior to reaching the Coal Creek There may be potential impacted to these draws by the landfill sites. The north draw is located on the north side of the Laidlaw North site. The middle draw, which previously ran through the Pratt property and the Laidlaw South site, is now covered with waste. The south draw flows to the south of the Laidlaw South property. The drainages are ephemeral and exhibit well developed channels.

* The landfill properties are surrounded by agricultural land.

* The nearest business is located 1/4 mile north of the Laidlaw North site. The business is Blake's Auto Salvage. It does not maintain any underground storage tanks and it does not have a domestic ground water well. Instead drinking water is hauled from Longmont and stored in an under ground cistern. The site is well maintained and does no appear to be the site of indiscriminate dumping or spillage. However, a historical research of the facility operations was not performed.

* The nearest resident is located approximately 1/4 mile for the landfill site. The nearest residential neighborhood is located approximately 1 mile to the southeast of the landfill site.

* The nearest municipal wells are located approximately 1 mile to the southeast of the site and serve some of the Ranch Eggs neighborhood. The Town of Erie obtains its drinking water from Prince Lake located approximately 3 miles west of the site. The residents of Erie do utilize the shallow alluvial and shallow bedrock ground water for the purposes of lawn watering and irrigation only.

5.0 DATA VALIDATION

5.1 Organics Data Validation

Organics case number 16040 (sampled on March 19, 1991) included volatile organics, semi-volatile organics, PCB and pesticides. See Table 4 for sample tag numbers, figure 7 for corresponding sample locations and Appendix C for validated data. Data was acceptable for use with the following qualifications:

* SOW VOA holding times (7 days from receipt to analysis) were met for all of the samples with the exception of HG793 VOA and HG796 VOA. Holding times for these samples were exceeded by one day. No flags were used for this minor holding time violation.

* 40 CFR 136 VOA holding times (7 days from sampling to analysis) were not met for any samples. Samples were analyzed 8 to 9 days from sampling collection date. This is not a gross violations, and no flags were used to qualify sample results.

* Surrogate compound recovery analysis (phenol d5) was outside of the contract requirements in HG794 - BNA, HG799 - BNA and HG828 - BNA. No corrective action or flags were required.

* Matrix Spike/Matrix Spike Duplicate analyses were outside of the contract requirements for the BNAs for 0 of 11 RPD values and 3 of 22 spike recovery values. No apparent matrix effects problems were noted. Therefore no flag qualifiers were used.

* Matrix Spike/Matrix Spike Duplicate analyses were outside of the contract requirement for the PCB/pesticide for 6 of 12 spike recoveries and 6 of 6 RPD values. These results indicate possible matrix effect problems. Surrogate recoveries were within the contract requirements and no positive sample results were found.

* Methylene chloride and Butylbenzylphthalate were found in laboratory blanks. Associated samples having concentrations for these compounds less than 10x in the blank were flagged "UB." These compounds are common laboratory contaminants.

* The identities and concentrations of TIC's should be considered tentative and estimated. All TIC results flagged "J."

Organics case number 16256 (sampled on April 18, 1991) included volatile organics, semi-volatile organics, PCB and pesticides. See Table 5 for sample tag numbers, figure 7 for corresponding sample locations and Appendix C for validated data. Data was acceptable for use with the following qualifications:

* Low end instrument response (RF) was obtained for Benzoic acid, 2,4,5-Trichlorophenol, 2-Nitroanaline, 3-Nitroanaline, 2,4-Dinitrophenol, 4-Nitrophenol, 4-Nitroanaline, 4,6-Dinitro-2-methylphenol. Non-detected sample results for these analytes were flagged "UJ", since the detection limits are estimated.

* Compound recovery analysis for 1 of 6 BNA surrogates was out of the contract requirements. No corrective action or flags were required.

* DBC pesticide/PCB surrogate recovery was only 23% for HJ918. All samples were flagged "UJ."

* BNA matrix spike/matrix spike duplicates analysis for 3 of 11 RPD values and 3 of 22 spike recovery values were out of the control limits set by the contract requirements. Internal standards and surrogates for BNAs were off, therefore no flags.

* Ten of 12 spike recovery values and 2 of 6 RPD values were out of the control limits set by the contract requirements. These poor results together with the low surrogate recovery value indicate a matrix effect problem for the pesticide analysis. Pesticide results were flagged "UJ".

* The VOA blanks had several unidentified peaks. The pesticide/PCB blank had unconfirmed potential low level contamination of beta-BHC and Heptachlor epoxide. No flags were necessary for these potential blank problems.

* Sample chromotographs indicated that trace amounts of gamma-BHC, beta-BHC, and Heptachlor epoxide were present, although these results were unconfirmed. Note that beta-BHC and Heptachlor epoxide were also found at similar concentrations in the lab blank.

* The identities and concentrations of TIC's should be considered tentative and estimated. All TIC results are flagged "J".

5.2 Inorganics Data Validation

Inorganics data Case Number 16040 (sampled March 19, 1991) included twenty-three metals. See Table 6 for sample tag numbers, figure 7 for corresponding sample locations and Appendix C for validated data. Data was acceptable for use with the following qualifications:

* No blank contaminants were found at concentrations above the CRDL.

* Elements As, Se and Tl had spike recovery values below acceptable limits. Sample results for these elements may be biased approximately 50% low, based on the matrix spike recovery results. These samples were flagged "J" for positive results and "UJ" for sample detection limits.

* The %D values for Ca and Na exceeded the 10% control limit. Positive sample results for these elements were flagged "J" and sample detection limits were flagged "UJ" due to poor ICP serial dilution results.

* Samples MHP885, MHP887 and MHP891 required dilution, thus Arsenic detection limits are elevated for these samples. Similarly, Selenium detection limits for samples MHP905, MHP887 and MHP891 were also elevated. The following samples had low analytical spike recovery values: for As MHP888, MHP889, MHP887, MHP892, MHP905; for Pb MHP885, MHP887, MHP888, MHP889, MHP891; for Se MHP905, MHP889; for Tl MHP885, MHP887, MHP888, MHP889, MHP891, MHP905. For each of the analytes, positive sample results for the samples listed were flagged "J" and sample detection limits were flagged "UJ."

Inorganics Case Number 16256 (sampled on April 18, 1991) included twenty-three metals. See Table 7 for sample tag numbers, figure 7 for corresponding sample locations and Appendix C for validated data. Data was acceptable for use with the following qualifications:

* Aqueous sample duplicate results for Pb and Se were out of the control limits. Positive results for these elements were flagged "J."

* Aqueous spike results were out of the control limits for Pb and Tl. Positive results for these elements were flagged "J" and sample detection limits were flagged "UJ."

* Soil spike results were out of the control limits for Tl, Sb, Ba and Ag. Positive results for these elements were flagged "J." Sample detection limits for Tl were flagged "UJ", and sample detection limits for Sb were flagged "R."

* Aqueous serial dilution results for Ba, Ca and Mg were out of the control limits. Positive aqueous sample results for these elements were flagged "J."

* AA analytical spikes were out for the following sample results: MHP916 As and Tl; MHP918 Tl; and MHP919 Se and Tl. Positive results for these sample analytes were flagged "J" and detection limits were flagged "UJ."

6.0 RESULTS

6.1 Waste Characteristics

Specific wastes were not sampled as part of the SSI. However, possible wastes associated with the Pratt property are documented as being disposed at the site are methyl-ethyl-ketone and torpedo propellant. Other compounds associated with the IBM manufacturing process which may have been disposed of at the site are: No. 1, No. 2 and No. 6 fuel oil, liquid nitrogen, methyl ethyl ketone, trichlorofluoroethanol, 1,1,1-trichloroethane, toluene, tetrahydrofuran, methylene chloride, n-butylamine, ethylene diamine, ammonia and sulfuric acid.

The Pratt property is approximately 35 acres, the Laidlaw North site is approximately 80 acres and the Laidlaw South site is approximately 160 acres. The waste volume for the three sites has been estimated at 8,700,000 cubic yards of solid waste. IBM has reported disposing of 1500 55 gallon drums of chemical waste at the Pratt property. Sundstrand allegedly disposed of an unknown quantity of torpedo propellant, which was burned in container lined pits. Unknown quantities of various chemical wastes may have also been disposed on the Pratt property. The Columbine landfill has reportedly received a variety of oil wastes, sand and grease trap sludges.

6.2 Air Migration Pathway

Characterization of the air pathway by air sampling was not within the scope of this screening site inspection. The landfill sites are capped with either daily, intermediate or final cover. A small portion of the landfill face is open daily for refuse disposal and is covered every evening. A review of contaminants detected in the off-site sediment samples (collected for the SSI) reveals the presence of a number of Tentatively Identified Compounds (TIC). Generally, they were identified as unknown hydrocarbons. The compounds found were within the top two feet of pond #1 and pond #4 (see table 5 and 7).

6.2.1 Population Available To The Air Pathway

The target population potentially exposed to the air pathway is: twenty-two on-site individuals are within a 0 to 1/4 mile radius from the site, three individuals are within a 1/4 to 1/2 mile radius from the site, approximately 16 individuals are within a 1/2 to 1 mile radius from the site, approximately 1500 individuals are within a 1 to 2 mile radius from the site, approximately 600 individuals are within a 2 to 3 mile radius of the site, and approximately 600 individuals are within a 3 to 4 mile radius of the site. The target population figure estimates are based on 2.5 individuals per household in Weld County. The radius of influence maps are shown in figure 8 of this report.

6.3 Ground Water Migration Pathway

Ground water samples were collected for this screening site investigation. The ground water samples fell into three categories: on-site landfill monitoring wells, domestic use ground water wells and background site investigation wells. Summaries for the volatile organic compounds, the semi-volatile organic compounds, PCB/pesticides and metals are presented in tables 1 through 6.

6.3.1 Summary Of SSI Analytival Results

Background wells (CL-SI-MW-1 AND CL-SI-MW-2B) were drilled and sampled at the locations shown on figure 7. Only VOA's were collected for CL-SI-MW-2B due to insufficient recharge to the well during the sample event. The VOA trip blank did not contain any identified compounds. The rinsate blank contained Acetone and Toluene. Aside from these apparent sampling induced contaminates, sample results are considered valid. CL-SI-MW-1 analytical results did not identify any volatile, semi-volatile or PCB/pesticide compounds. CL-SI-MW-1 analytical results identified one volatile compound, benzene at 10 ug/l (table 5).

A metals sample was not collected for CL-SI-MW-2B due to insufficient recharge to the well during the sample event. A metals sample was collected from CL-SI-MW-1. Generally the metals found in CL-SI-MW-1 are at the detection limit or of lesser concentration than the landfill on-site monitoring wells and the Laramie-Fox Hills Aquifer wells; with the exception of aluminum, barium, copper, iron, lead, and zinc. No explanation can be found for this variance aside from natural differences in the background water chemistry in comparison to the other sample locations.

Three on-site landfill monitoring wells were sampled: CL-LF-GW-3 (GW1) located upgradient of the Pratt property, CL-LF-GW-4 (204A) located at the north end of the Laidlaw North property and CL-LF-GW-5 (GW8) located downgradient of the Laidlaw South property (see figure 7). The full suite of volatile compounds, semi-volatile compounds, PCB/pesticides and metals were analyzed for all landfill samples collected, with the exception of GW8. The well had poor recharge and a full sample could not be collected on the sampling day. Laboratory blank analysis results contained methylene chloride and butyl-benzylphthalate. The VOA trip blank contained methylene chloride and the rinsate blank did not contain any identified compounds. Aside from these apparently induced contaminants, sample results are considered valid. CL-LF-GW-3 (GW1) and the duplicate (GW1 DUP) analytical results identified benzene at 5 & 6 ug/l, dichlorofluoromethane (TIC) at 7 & 8 ug/l and various other unknown TIC compounds. CL-LF-GW-5 (GW8) analytical results identified benzene at 26 ug/l, 1,1-dichloroethane at 18 ug/l, dichlorofluoromethane (TIC) at 20 ug/l, tetrahydrofuran (TIC) at 58 ug/l. CL-LF-GW-4 (204A) analytical results identified 2-fluoro-4-nitrophenol (TIC) at 10 ug/l and various other unknown TIC compounds.

The landfill on-site monitor wells either were below detection limit or were generally of higher concentrations than the background well (except were noted above). Appendix D graphically depicts the concentration relationships of the SSI samples collected. Metals which exceeded detection limits and also background concentrations by at least 2X were: antinomy, arsenic, magnesium, potassium, sodium, silver and thallium.

Three domestic Laramie-Fox Hills Aquifer wells were sampled: CL-PP-GW-2 (Zahn), CL-PP-GW-3 (Horst) and CL-PP-GW-7 (Laidlaw) (figure 7). CL-PP-GW-2 (Zahn) analytical results identified benzene at 3 ug/l, 2-fluoro-4-nitrophenol (TIC) at 14 ug/l and various unknown TIC compounds. CL-PP-GW-3 (Horst) analytical results identified various unknown TIC compounds. CL-PP-GW-7 (Laidlaw) analytical results did not identify any compounds.

Metals analyses were performed on all three domestic Laramie-Fox Hills Aquifer wells which are shown graphically in Appendix D. Basically, the samples demonstrated a ground water of good quality and which is apparently unaffected by landfilling activities at the site. The exception to this is the Zahn well, where various metals were consistently elevated above the other two domestic wells and in some cases above the on-site landfill monitor wells. Specifically, the metals of antimony, calcium, magnesium, manganese and thallium were at least an order of magnitude higher in concentration than the other domestic wells. A possible explanation for the order of magnitude difference in concentration is the fact the Zahn well was not purged prior to sample collection. The Zahn well head could not be sampled directly since it feeds into an above ground 5000 gallon holding tank. Water sits in the tank until the water level is lowered enough to trip the pump. The holding tank was approximately 2/3 full at the time of sample collection. The sample water quality may be adversely impacted by the tank itself and is therefore not representative of ground water quality at the location of that Zahn Laramie-Fox Hills well.

6.3.2 Summary Of Ground Water Pathway Impacts

Based on the analyses provided above, the landfill is impacting the local ground water quality. There is no evidence of adverse impact to the background wells and to the Laramie-Fox Hills wells. Volatile and semi-volatile constituents are documented as present in the shallow bedrock aquifer. Tetrahydrofuran, a Tentatively Identified Compound, is a possible IBM manufacturing waste that may have been disposed in the Pratt property. Research at the PA stage did not identify compounds such as benzene and 1,1-dichloroethane as specifically disposed at the Pratt property. However, these compounds are common to municipal solid waste landfill leachate. Dichlorofluoromethane (aka Freon 11) and 2-fluoro-4-nitrophenol (a synthetic compound) are not as commonly found in municipal wastes, but have been seen at old landfills that have a history of questionable landfill practices.

The following summarizes the possible source and human effects of constituents detected in the ground water:

> Benzene has an acute human toxicity from ingestion or inhalation. Possible sources for benzene are medicinal chemicals, dyes,airplane dopes, varnishes, lacquers, and as a solvent for waxes, resins and oils.
>
> Tetrahydrofuran is miscible with water, alcohols, ketones, esters, and hydrocarbons. The substance is irritating to skin, eyes, and mucous membranes. It is used as a solvent for high grade polymers and in histological techniques, as reaction medium for Grignard and metal hydride reactions and in the synthesis of butylrolactone, succinic acid, and 1,4-butanediol diacetate.
>
> Dichlorofluoromethane is soluble in alcohol and ether and insoluble in water. The substance has little, if any anesthetic of toxic action but toxic substances may be formed on contact with a flame or hot metal surface. It is primarily used as a refrigerant or aerosol propellent.

The elevated metals such as magnesium, potassium and sodium are generally indicative of basic ground water quality. These elevated constituents with respect to the other samples demonstrate that water quality is being adversely affected. Metals such as antimony, arsenic, silver and thallium are not commonly analyzed in landfill monitoring programs and so there significance is not clear. However, their source and human toxicity potential is summarized below.

Antimony and its compounds have been reported to cause dermatitis, keratitis, conjunctivitis and nasal septal ulceration by contact, fumes or dust. Stibine (SbH3) can be liberated from storage batteries when nascent hydrogen reacts, in an acid medium, with antimony present in the battery plates. In manufacture of alloys, such as hard lead, white metal, type, bullets and bearing metal; in fireworks; for thermoelectric piles, blackening iron, coating metals, etc. antimony is used.

Arsenic is toxic in most forms. Acute symptoms following ingestion relate to irritation of the G.I. tract: nausea, vomiting, diarrhea, which can progress to shock and mentation of skin, herpes, polyneuritis, altered hematopoiesis, degeneration of liver and kidneys. Arsenic is used in metallurgy for hardening copper, lead, alloys and in the manufacture of certain types of glass. The artificial Ar 76 is used as a radioactive tracer in toxicology.

Silver does not cause serious toxic manifestations, but prolonged absorption of silver compounds can lead to grayish blue discoloration of skin, known as argyria or argyrosis. Inhalation of dust should be avoided. Many silver salts are irritating to skin and mucous membranes. Silver is used for coinage and most frequently allowed with copper or gold. It is used in the manufacture to tableware, mirrors, jewelry etc; in handling organic acids; as a catalyst in hydrogenation and oxidation processes; and for purification of drinking water because of its toxicity to bacteria and lower forms of life.

Thallium causes symptoms of acute toxicity including nausea, vomiting, diarrhea, tingling, pain in extremities, weakness, coma, convulsions and death. Chronic symptoms include weakness, pain in the extremities and loss of hair. Thallium salts are used as an admixture with 97-98% of inert substances used as poison for rats and other rodents. Thallium is also used in semi-conductor research; alloyed with mercury for switches and closures which operate at subzero temperatures.

6.3.3 Population Available To The Ground Water Pathway

The population served by ground water within a 4 mile radius of the site is summarized as: from 0 to 1/4 mile one Laramie-Fox Hills domestic well serves approximately 22 on-site workers at the landfill site; from 1/4 to 1/2 miles one Laramie-Fox Hills domestic well serves 2 individuals; from 1/2 to 1 miles four alluvial wells serve approximately 10 individuals; from 1 to 2 miles 120 domestic wells (alluvial and Laramie-Fox Hills) serve approximately 300 individuals; from 2 to 3 miles 150 domestic wells (alluvial and Laramie-Fox Hills) serve approximately 375 individuals and from 3 to 4 miles 150 domestic wells (alluvial and Laramie-Fox Hills) serves approximately 375 individuals (figure 8).

municipal supply wells for the Ranch Eggs Estate.

6.4 Surface Water Migration Pathway

Two surface water samples were planned within the south draw for Pond #1 and Pond #4. The ponds dried up prior to sampling. Therefore, surface water samples were not taken and the potential to release to surface water could not be documented. However, it should be noted that the streams are ephemeral and are dry for at least half of the year.

The north draw, middle draw and south draw drain westward to Coal Creek. Figure 10A shows the surface water sample locations on Coal Creek, a south-to-north flowing stream, located immediately west of the site. Sample point 301 is located the near the outfall of the middle draw where it enters Coal Creek, sample point 302 is located downgradient of the landfill and sample point 303 is located upgradient of the landfill. Note that 301 and 302 has been sampled since December 1984, while 303 was not added to the sample program until June 1987. Figures 10B-10M graphically compares the water chemistry history for 301, 302 and 303. Generally, the analyte concentrations shown on the figures track each other (i.e. the concentrations are nearly identical). Exceptions to the tracking behavior begin at the June 1989 sample event. Sample location 301, the point closest to the middle draw begins to diverge (in concentration) from 302 and 303. The graphs depict that the three sample points are tracking each other in concentration prior to June 1989. After that date point 301 is not tracking with 302 and 303 as before. This may be a temporary event, or it may be the beginning of a trend. At this time conclusive statements can not be made about possible effects of the landfill on Coal Creek.

Two sediment samples were taken within the Pond #1 and Pond #4 area. Sediments samples were collected with a hand auger at a depth of approximately 12" beneath the ground surface. Various unknown hydrocarbons were Tentatively Identified in sample CL-SI-SO-1 (Pond #1). Sample CL-SI-SO-2 (Pond #4) analyses identified acetone at 50 ug/l and toluene at 67 ug/l. However, both of these constituents were also identified in the rinsate blank. No other volatile organics were detected in CL-SI-SO-2. Metals results for the two sediment samples are presented in table 6. Generally, the results were comparable with the following exceptions: CL-SI-SO-1 exceeded CL-SI-SO-2 by two orders of magnitude for copper (4210 ug/l vs 23.9 ug/l) and by one order of magnitude for silver (15.3 ug/l vs 1.1 ug/l); CL-SI-SO-2 exceeded CL-SI-SO-1 by one order of magnitude for barium (1760 ug/l vs 470 ug/l). Although the area around Pond #1 did not exhibit any signs of stressed vegetation or effects of disposal; due to the location and proximity of the south draw to the landfills it may be presumed that the area may have had some inappropriate disposal activities.

6.4.1 Population Available To The Surface Water Pathway

The targets associated with the surface water pathway are minimal. No surface water intakes are present on Coal Creek. Three and one half mile downstream from the site, Coal Creek joins with Boulder Creek. Boulder Creek has a number of canals which divert water for stock and irrigation purposes. Figure 9 shows the 15 mile downstream area of influence. The Town of Erie located approximately 1 1/2 downstream of the site does not use ground water for domestic purposes. Instead, it obtains its drinking water from Prince Lake located several miles to the west of town. Alluvial wells are utilized by Erie residences for lawn watering and irrigation.

6.5 Soil Exposure Pathway

Soil samples were not collected for this SSI. The Pratt property received a proper final cover in 1988. The Laidlaw South and Laidlaw North landfills receive appropriate daily and intermediate cover. The three landfill areas together total 275 acres. Waste is not exposed in any area. Perimeter fencing is placed to restrict unauthorized access. There is a very low probability of direct contact with the waste.

6.5.1 Population Available To The Soil Exposure Pathway

The potential for a soil exposure pathway would be typical of most landfills. The target population potentially exposed to the soil exposure pathway is: twenty-two on-site individuals are within a 0 to 1/4 mile radius from the site, three individuals are within a 1/4 to 1/2 mile radius from the site, approximately 16 individuals are within a 1/2 to 1 mile radius from the site, approximately 1500 individuals are within a 1 to 2 mile radius from the site, approximately 600 individuals are within a 2 to 3 mile radius of the site, and approximately 600 individuals are within a 3 to 4 mile radius of the site. The primary target population are the twenty-two on-site workers.

7.0 CONCLUSIONS

Air Pathway

Potential releases to the air pathway are insignificant. Though the air pathway was not specifically sampled, the three sites are covered with daily, intermediate and final cover; as appropriate. Air exposure would be similar to that of other municipal solid waste facilities. Landfill gas emissions and explosive potential is the primary hazard identified in the air pathway.

Ground Water Pathway

Observed releases to the shallow bedrock units are documented by Wells CL-LF-GW-4 (204A), CL-LF-GW-5 (GW8) and CL-LF-GW-6 (GW1).

Specific constituents observed in these wells are Benzene, 1,1-Dichloroethane, Dichlorofluoromethane, Tetrahydrofuran and 2-Fluoro-4-nitrophenol. The shallow bedrock units consist of Upper Laramie Formation. The primary contaminant migration pathway is horizontal, following the westward draining topographic features at the site.

Contaminant migration from the Upper Laramie to the deeper Laramie-Fox Hills Aquifer is improbable because the aquifer is confined; however, the area is heavily faulted and fractured. Faults and fractures were not investigated as part of this SSI. Releases to the domestic use wells Horst (CL-PP-GW-1), Zahn (CL-PP-GW-2) and Laidlaw (Cl-PP-GW-7) were not observed.

Appendix D graphically compares metals detected in the wells sampled as part of the SSI and Appendix E graphically compares the two SSI wells (CL-SI-MW-1 and CL-SI-MW-2B) with selected on-site landfill wells. Generally, the metals in the on-site landfill wells are elevated above the SSI wells, indicating degraded water quality in the vicinity of the landfill with respect to background water quality. (The following assumptions are made: 1) none of the on-site wells can be construed as representative of background water quality; that is unaffected by the activities at the site, 2) the SSI wells are sampled from similar hydrogeologic units as the on-site landfill monitoring wells, and thus can be representative of background water quality. Due limited drilling and geologic evaluation performed for the SSI, evidence is not conclusive in this regard.)

The detected TCL (target compound list) constituents document shallow ground water contamination at the landfill site. The graphs show inorganic constituents elevated at the landfill site and therefore, indicate degraded ground water quality. Release to the Laramie Fox-Hills Aquifer was not observed.

<u>Surface Water Pathway</u>
Surface water samples could not be collected because the ponds were dry prior to and at the time of the scheduled sample event.

Sediment samples collected from Pond#1 and Pond#4 were comparable with the exception of three metals: copper, silver and barium. CL-SI-SO-1 exceeded CL-SI-SO-2 by two orders of magnitude for copper and by one order of magnitude for silver. CL-SI-SO-2 exceeded CL-SI-SO-1 by one order of magnitude for barium.

Surface water at Coal Creek has been analyzed since December 1984. The constituents are of similar concentrations. At the June 1986 sample event the chemistries of sample point 301 (located at the outfall of the middle draw into Coal Creek), and sample points 302 and 303 appear to diverge, where previously they tracked together. It can not be determined at this time if the divergence is temporary in nature or the beginning of a long term trend.

The middle draw historically flowed through the Pratt property and the Laidlaw South property to Coal Creek. The middle draw is beneath the landfill mass. Both GW1, located at the east end of the landfill in the middle draw and GW8, located at the west end of the landfill in the middle draw, had detectable levels of volatile and semi-volatile organics. Metals detected in GW1 and GW8 were elevated with respect to the background SSI well. Though there is no surface water flow from the middle draw to Coal Creek, alluvial flow is possible to Coal Creek.

Soil Exposure Pathway

Soil samples were not collected for the SSI. The sites have daily, intermediate and final cover as appropriate. The sites have perimeter fencing and access is restricted. There is a very low probability of direct contact with the waste. The soil exposure pathway would be typical of most well run municipal solid waste facilities.

8.0 REFERENCES

Colorado Department of Health (site files)

Colorado Division of Wildlife

Colorado State Engineers

Erie, Town of

Fish and Wildlife Assistance

Interview:

Armstrong, Gary; Rock Mountain Fuel Company, Owner of Columbine Mine

Hoffman, Richard; Manager of Laidlaw Regional Landfill

Horst, Daniel; Original Operator of Laidlaw North

IBM

Kiernes, Brad; Colorado Landfill, Inc.

Neuhauser, John F.; Co-owner of Sanitation Engineering, Inc.

Pratt, Kenneth; Owner of Pratt Property

Roweder, Barbara; Wife of Ralph Roweder

Sundstrand Aviation

Site Inspection to the Laidlaw North and South on 08/20/90 and 09/07/90

Weld County Assesors Office (site files)

Weld County Commissioners Office (site files)

Weld County Health Department (site files)

Weld County Planning Department (site files)

U.S. Geological Survey Topographic Maps

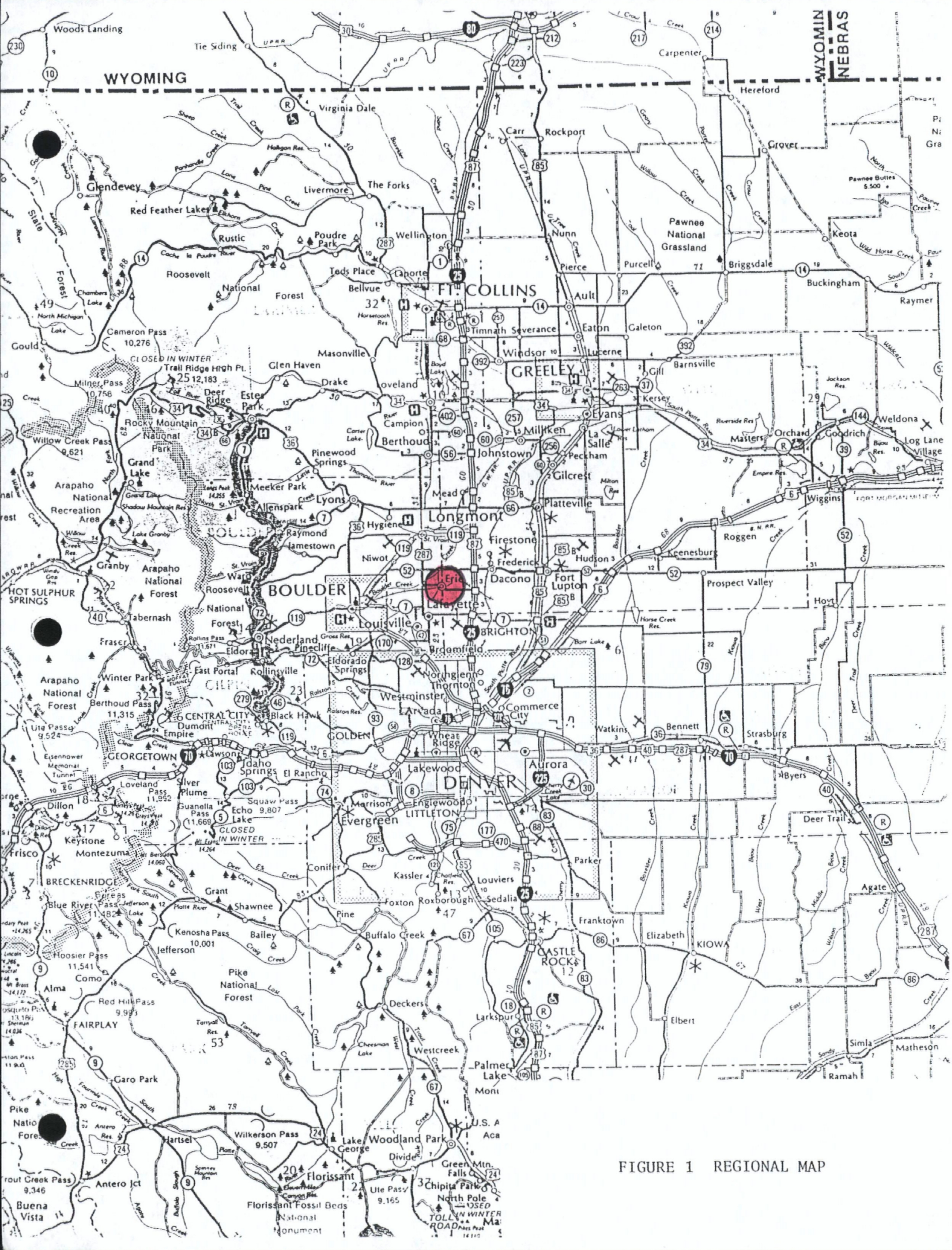

FIGURE 1 REGIONAL MAP

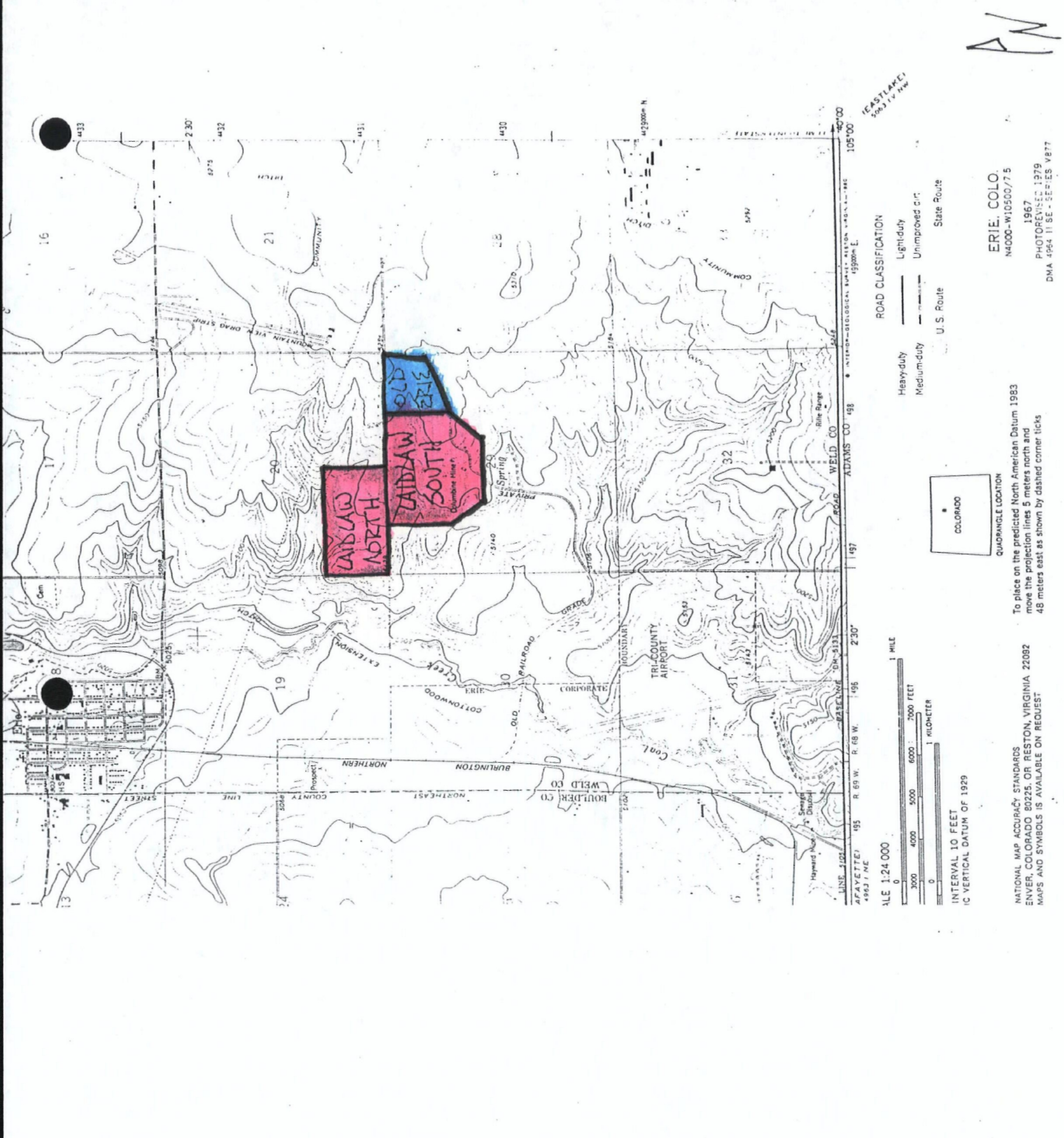

FIGURE 2 SITE MAP

EPA Notification of Hazardous Waste Site

United States Environmental Protection Agency Washington DC 20460

RECEIVED SEP 13 1990 HAZARDOUS MATERIALS AND WASTE MANAGEMENT

This initial notification information is required by Section 103(c) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 and must be mailed by June 9, 1981.

Please type or print in ink. If you need additional space, use separate sheets of paper. Indicate the letter of the item which applies.

A Person Required to Notify:

Enter the name and address of the person or organization required to notify.

Name: Voluntary Notification Identifying Past
Street: Disposal Activity of IBM Corporation
City: State: Zip Code:

B Site Location:

Enter the common name (if known) and actual location of the site.

Name of Site: Erie, Colorado Sanitary Landfill South
Street: and East of town
City: Erie County: Boulder State: CO Zip Code:

C Person to Contact:

Enter the name, title (if applicable), and business telephone number of the person to contact regarding information submitted on this form.

Name (Last, First and Title): Boggio, Robert Engineer
Phone: IBM Corporation, P.O. Box 1900
Boulder, Colorado 80302 (303) 447-7764

D Dates of Waste Handling:

Enter the years that you estimate waste treatment, storage, or disposal began and ended at the site.

From (Year): 1965 To (Year): June, 1969

IBM contributed an estimated 84,000 gallons of chemical waste to the Erie Landfill. The material was disposed of in approximately 1,500 55 gallon drums.

E Waste Type: Choose the option you prefer to complete

Option 1: Select general waste types and source categories. If you do not know the general waste types or sources, you are encouraged to describe the site in Item I—Description of Site.

General Type of Waste:
Place an X in the appropriate boxes. The categories listed overlap. Check each applicable category.

1. [X] Organics
2. [X] Inorganics
3. [X] Solvents
4. [ ] Pesticides
5. [ ] Heavy metals
6. [X] Acids
7. [X] Bases
8. [ ] PCBs
9. [ ] Mixed Municipal Waste
10. [ ] Unknown
11. [ ] Other (Specify)

Source of Waste:
Place an X in the appropriate boxes.

1. [ ] Mining
2. [ ] Construction
3. [ ] Textiles
4. [ ] Fertilizer
5. [ ] Paper/Printing
6. [ ] Leather Tanning
7. [ ] Iron/Steel Foundry
8. [ ] Chemical, General
9. [ ] Plating/Polishing
10. [ ] Military/Ammunition
11. [ ] Electrical Conductors
12. [ ] Transformers
13. [ ] Utility Companies
14. [ ] Sanitary/Refuse
15. [ ] Photofinish
16. [X] Lab/Hospital
17. [ ] Unknown
18. [X] Other (Specify) Manufacturing of magnetic media and associated lab development activit

Option 2: This option is available to persons familiar with the Resource Conservation and Recovery Act (RCRA) Section 300 regulations (40 CFR Part 261).

Specific Type of Waste:
EPA has assigned a four-digit number to each hazardous was listed in the regulations under Section 3001 of RCRA. Enter t appropriate four-digit number in the boxes provided. A copy o the list of hazardous wastes and codes can be obtained by contacting the EPA Region serving the State in which the site located.

Form Approved OMB No. 2000-0138
EPA Form 8900-1

FIGURE 3 EPA NOTIFICATION OF HAZARDOUS WASTE SITE

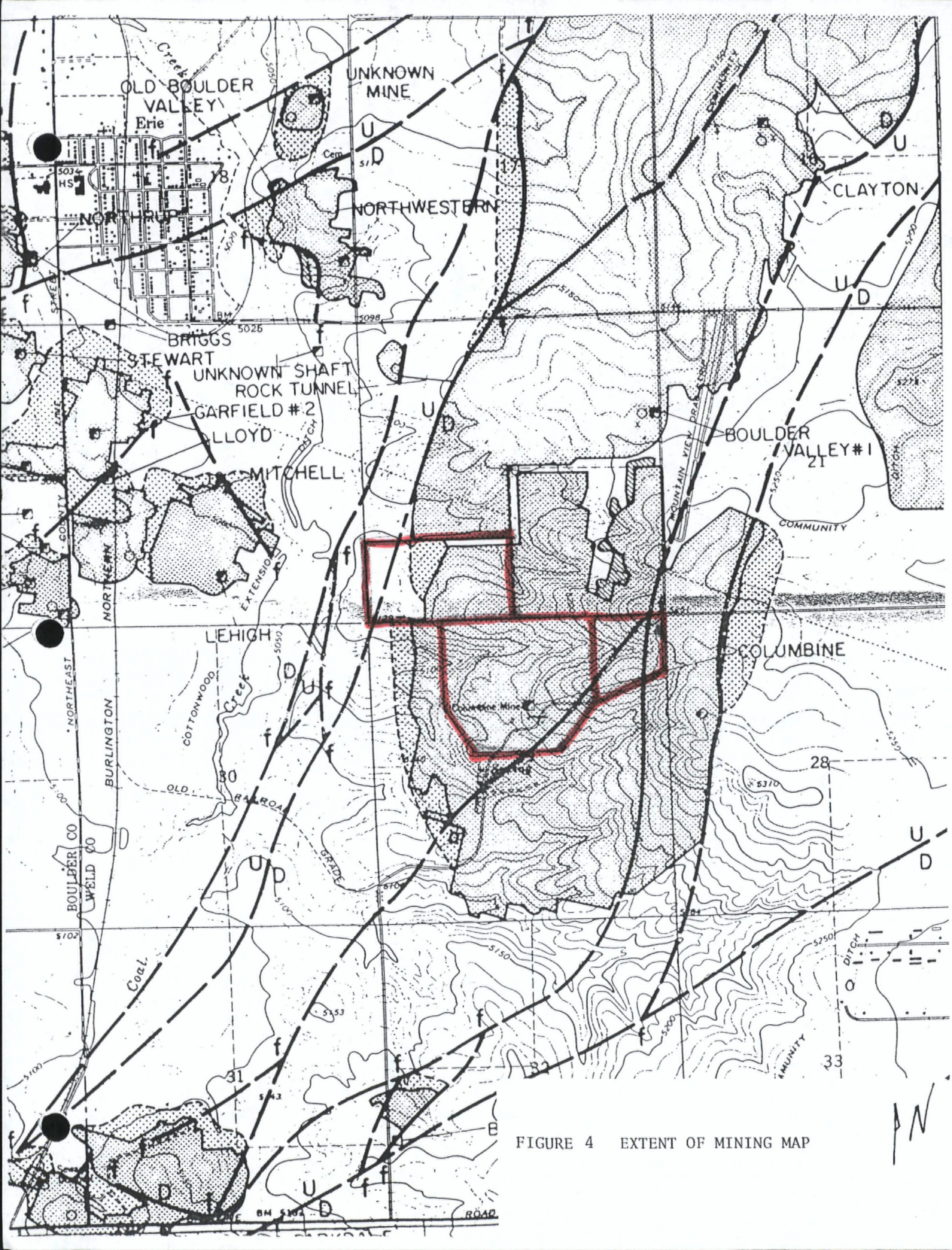

FIGURE 4 EXTENT OF MINING MAP

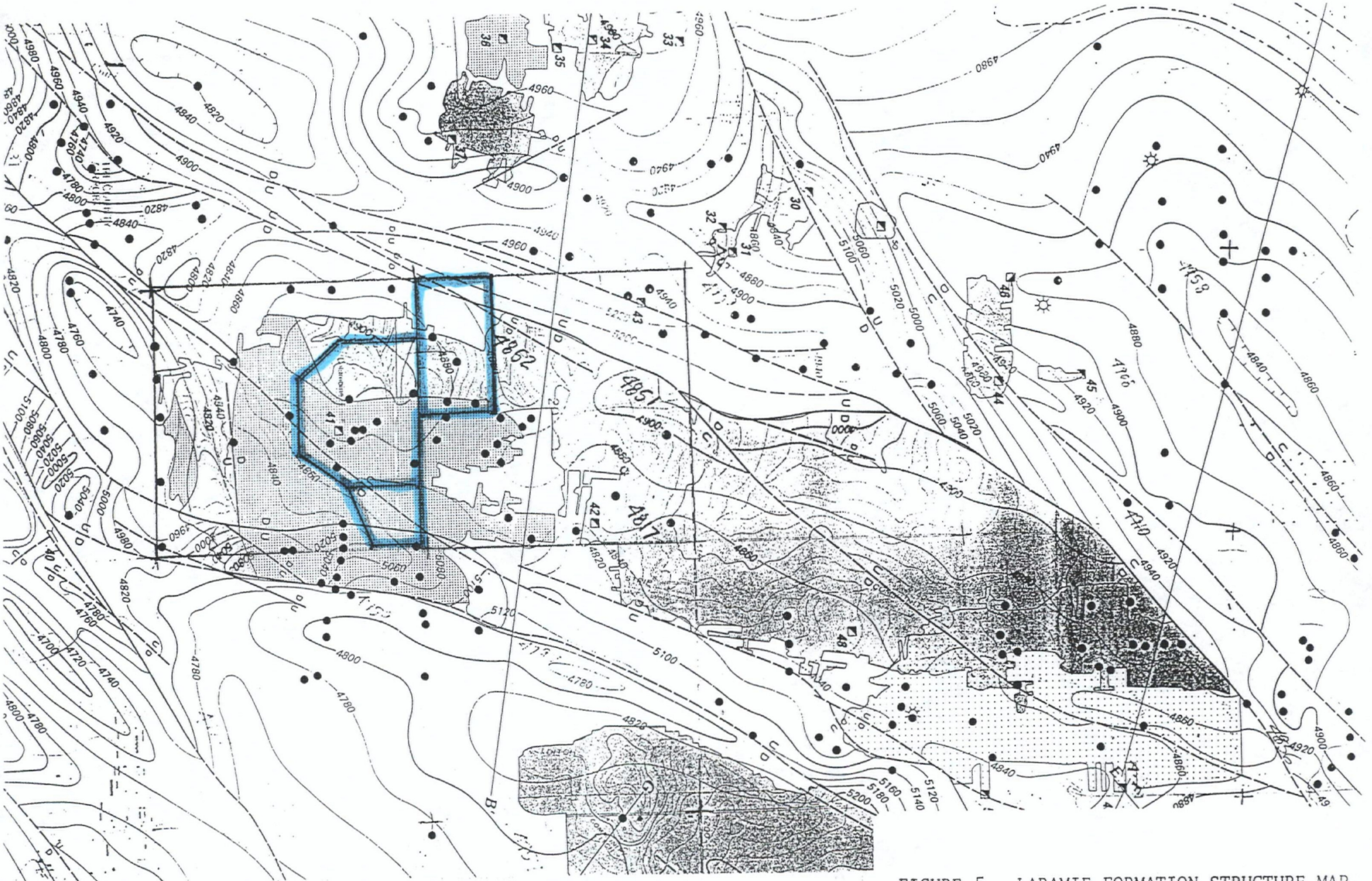

FIGURE 5 LARAMIE FORMATION STRUCTURE MAP

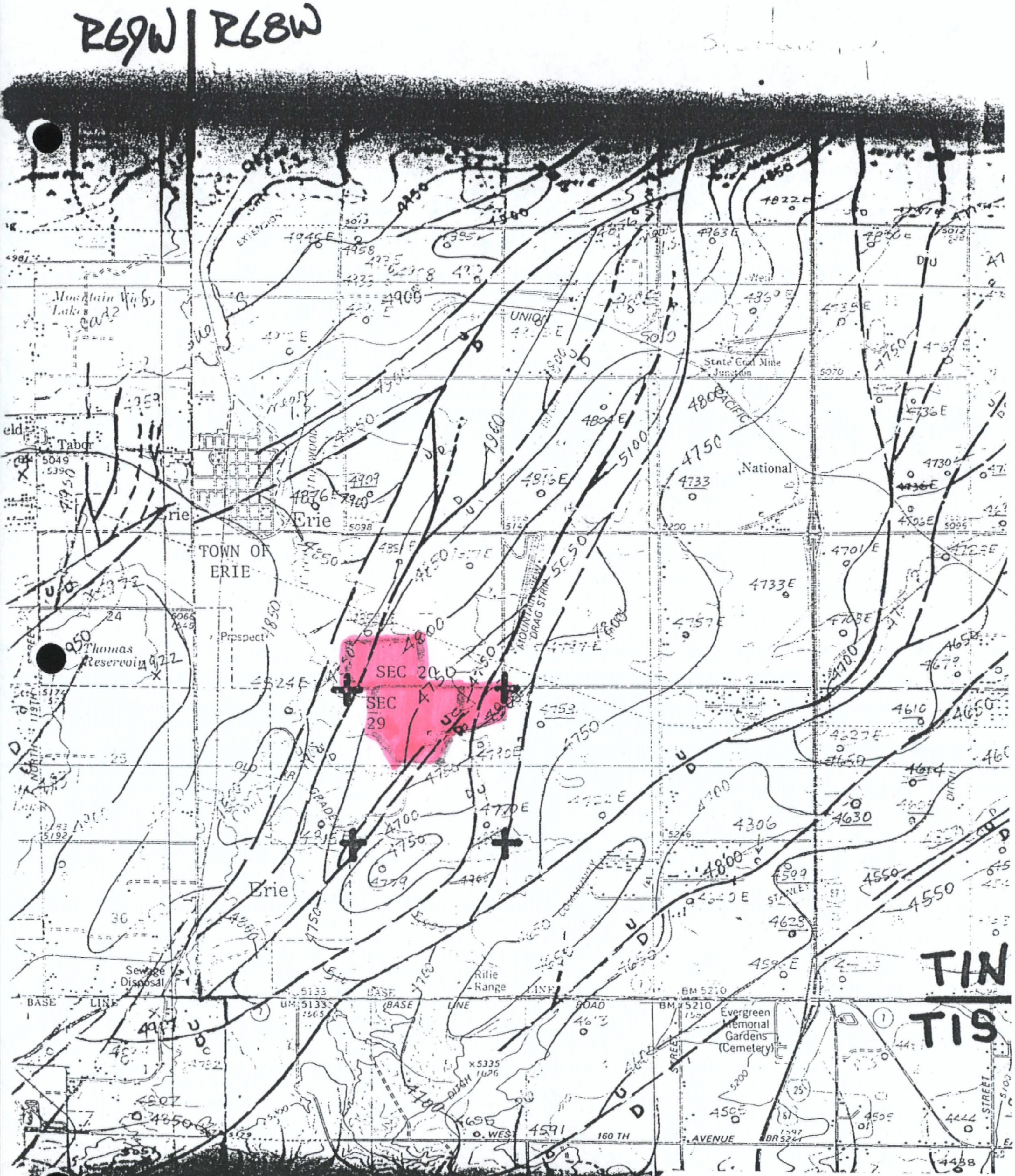

FIGURE 6 LARAMIE-FOX HILLS AQUIFER MAP

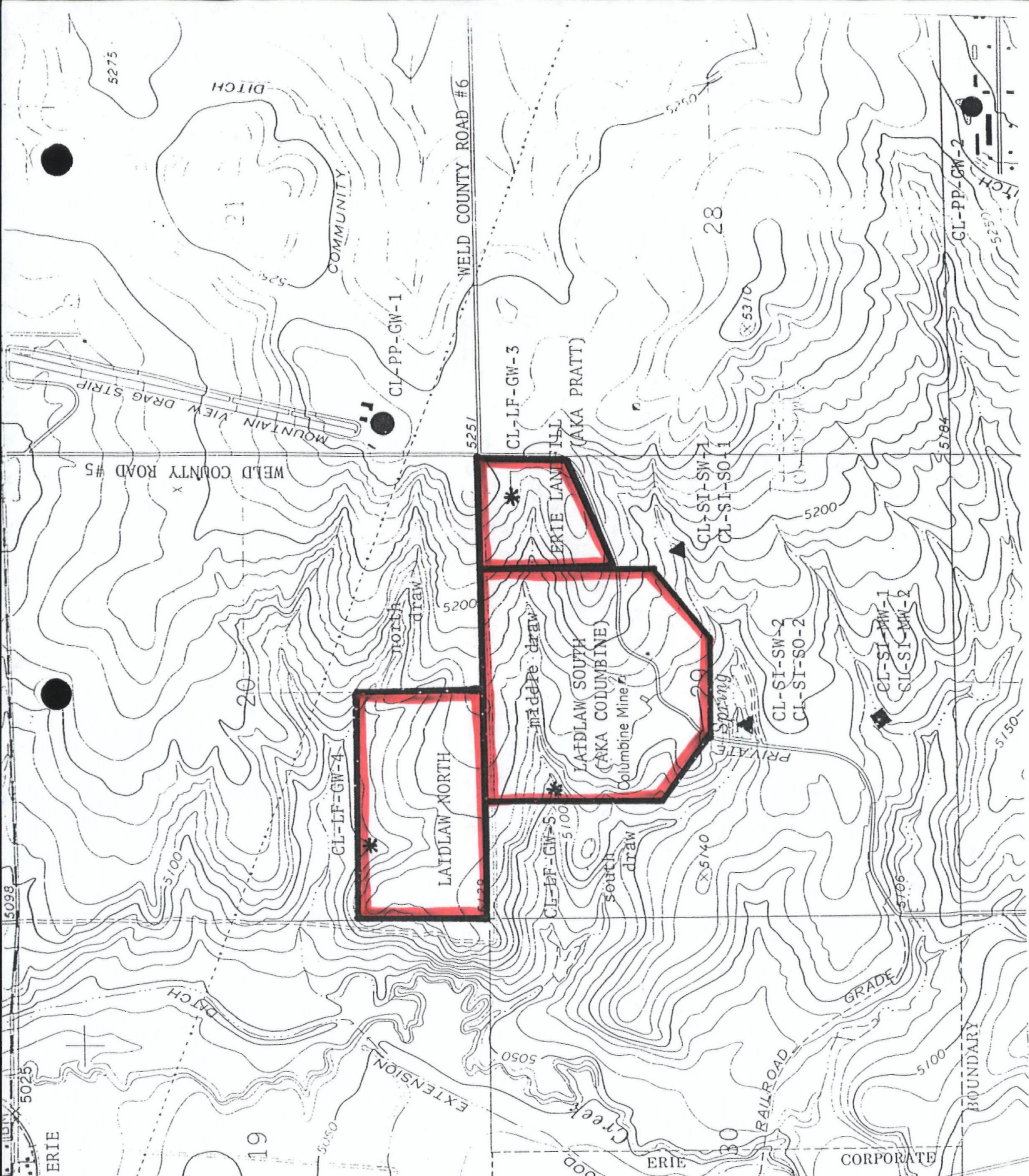

FIGURE 7 PROPOSED SAMPLE LOCATIONS

NORTH

- ● private propety wells
- ✱ on-site landfill well
- ◆ Site Investigation we
- ▲ surface water sample

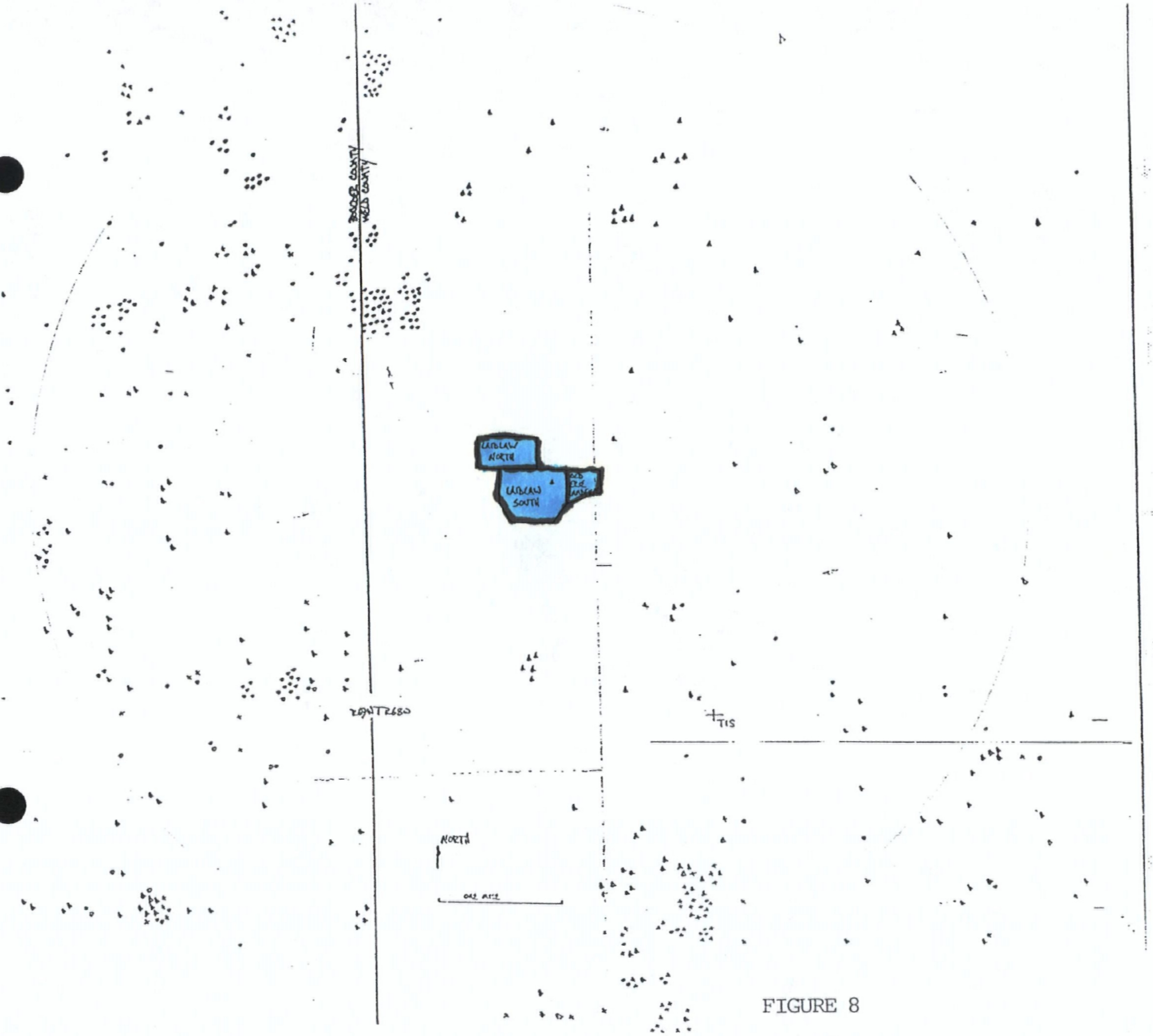

FIGURE 8

WELL LOCATED WITHIN A 4 MILE RADIUS OF THE SITE

O – WELLS < 100' DEEP
+ – WELLS ≥ 100' & < 300' DEEP
△ – WELLS ≥ 300' DEEP

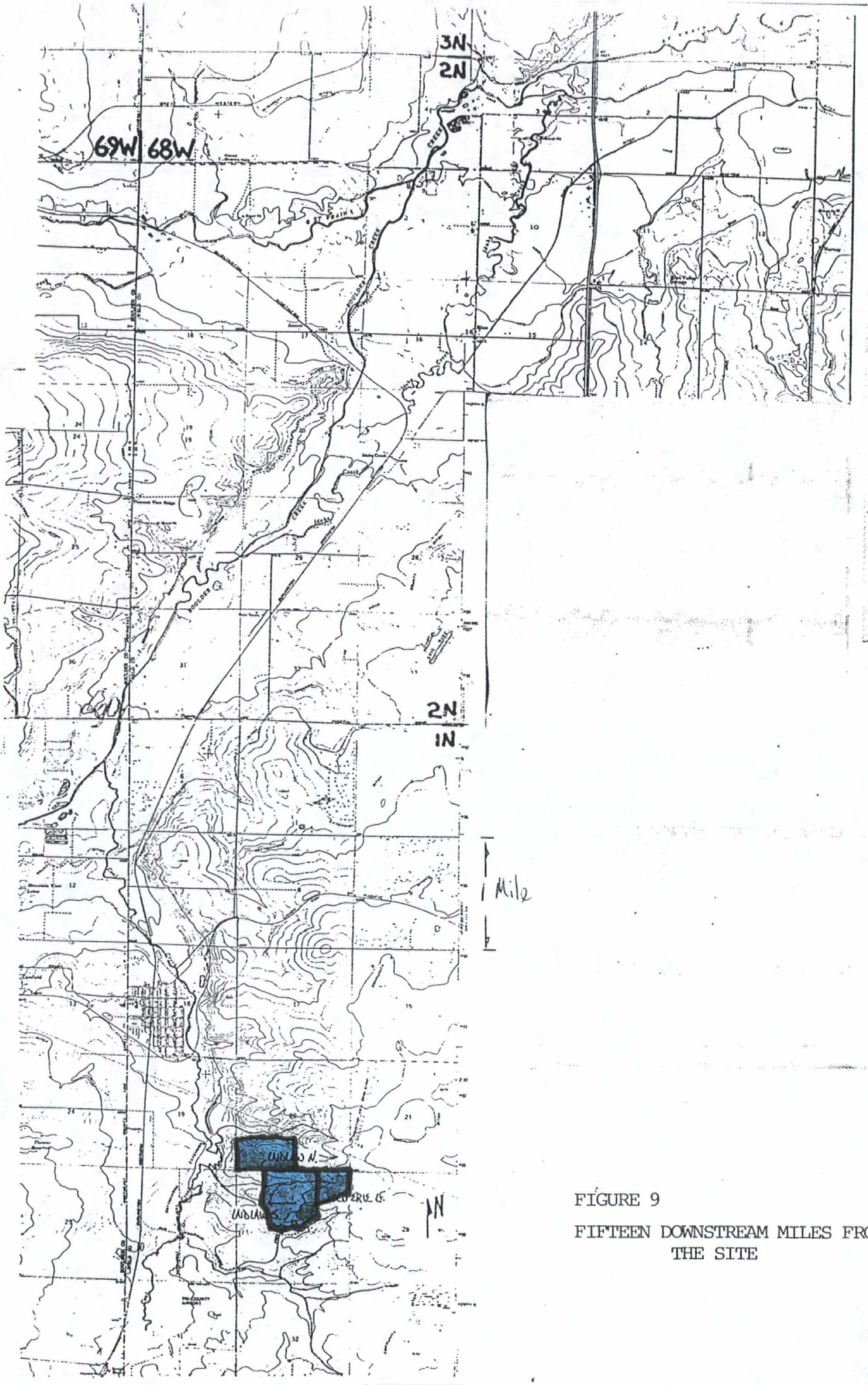

FIGURE 9

FIFTEEN DOWNSTREAM MILES FROM THE SITE

FIGURE 2

SURFACE WATER MONITORING SYSTEM

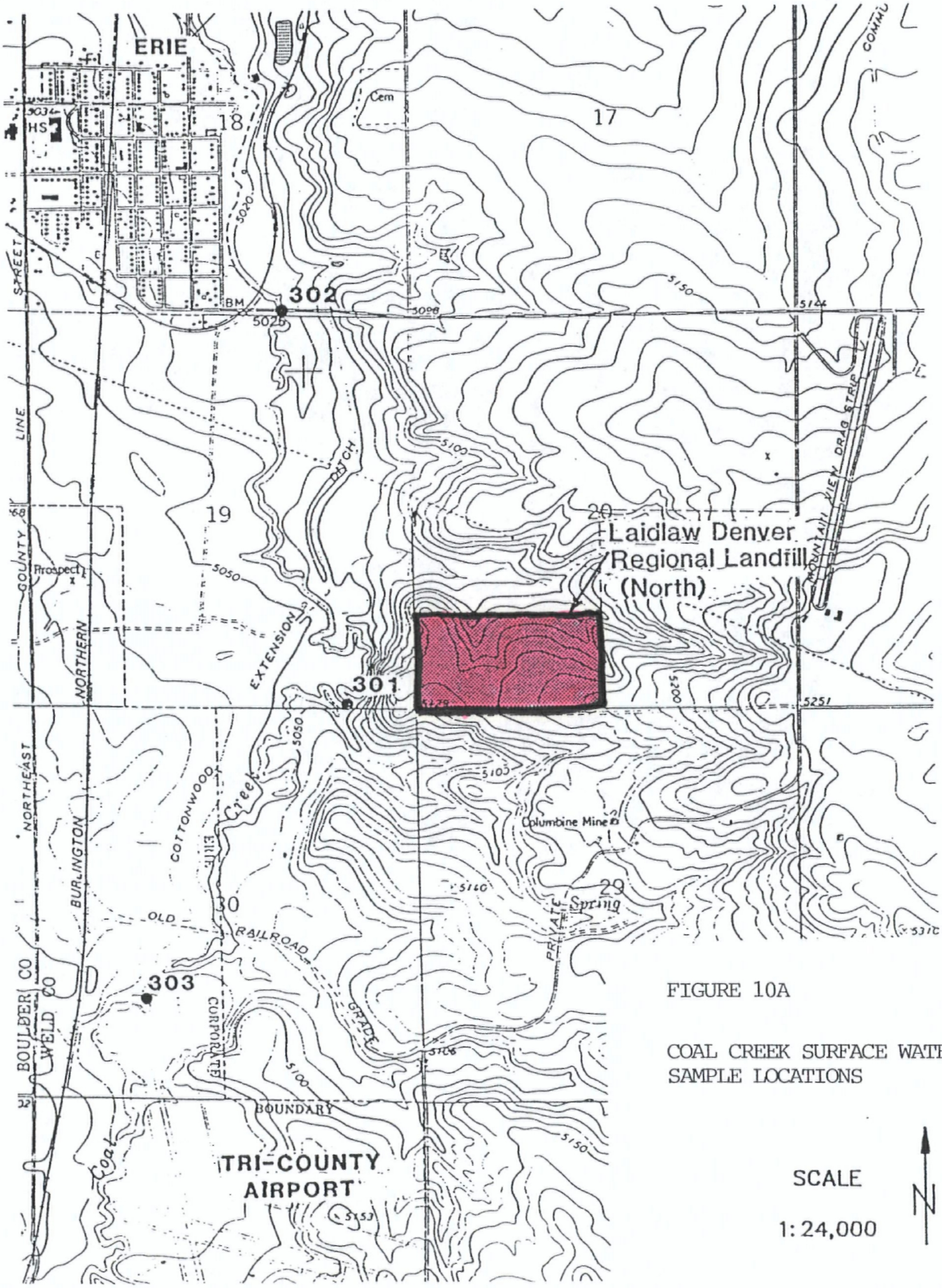

FIGURE 10A

COAL CREEK SURFACE WATER SAMPLE LOCATIONS

SCALE

1: 24,000

N

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FIGURE 16

TDS IN SURFACE WATER

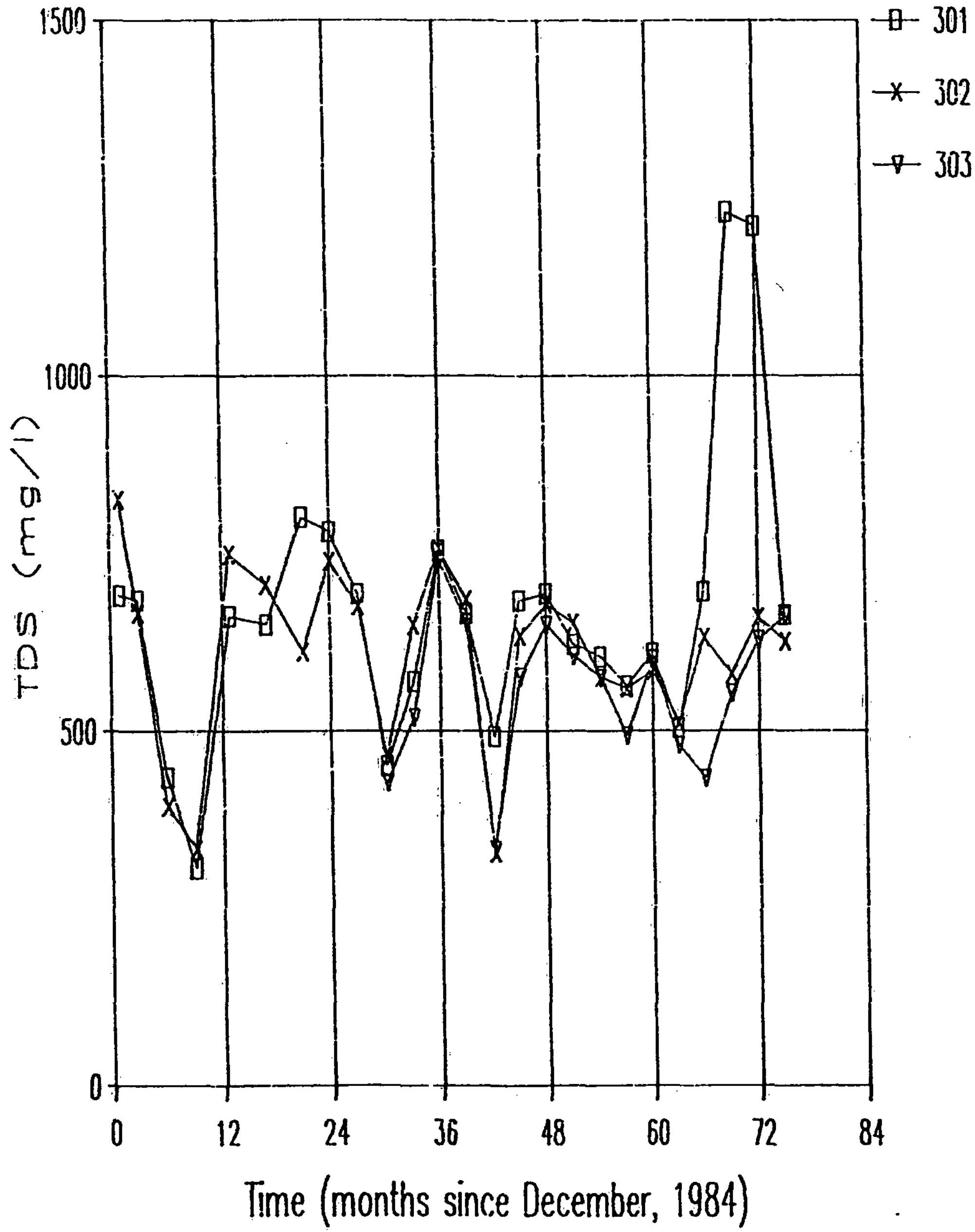

FIGURE 10B
COAL CREEK

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FIGURE 17

ZINC IN SURFACE WATER

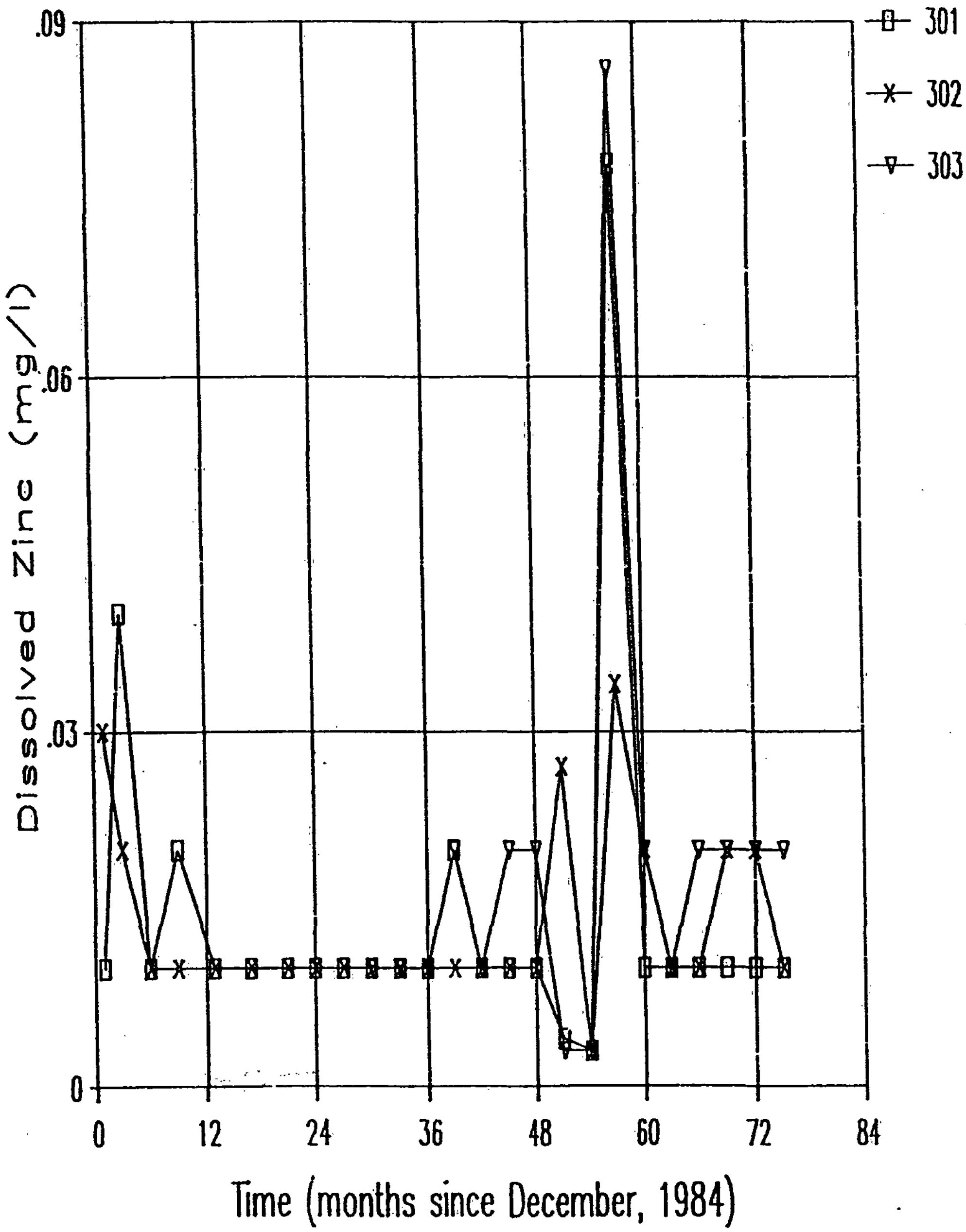

FIGURE 10C
COAL CREEK

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FIGURE 18

NITRATE + NITRITE IN SURFACE WATER

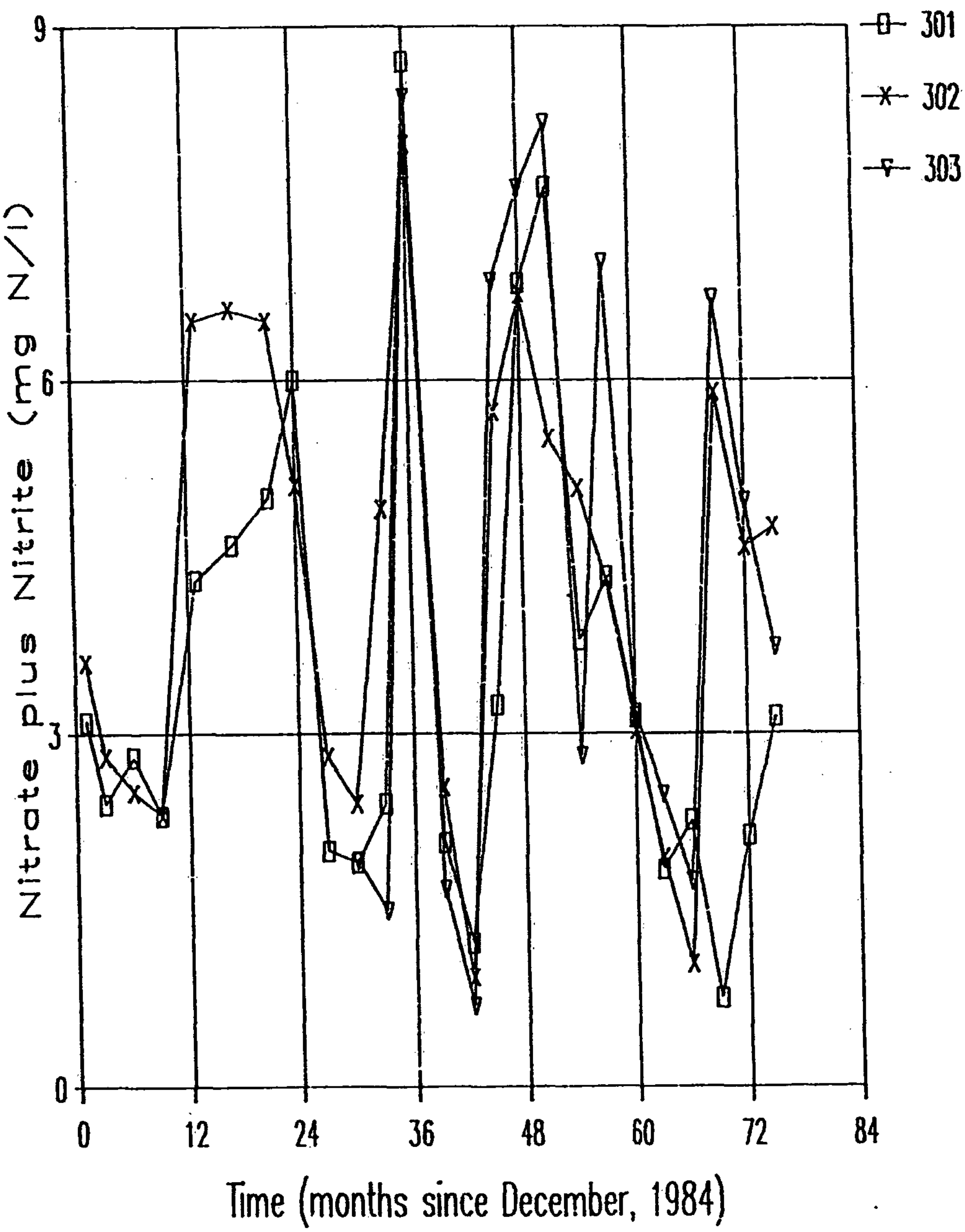

FIGURE 10D
COAL CREEK

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FIGURE 19

TOC IN SURFACE WATER

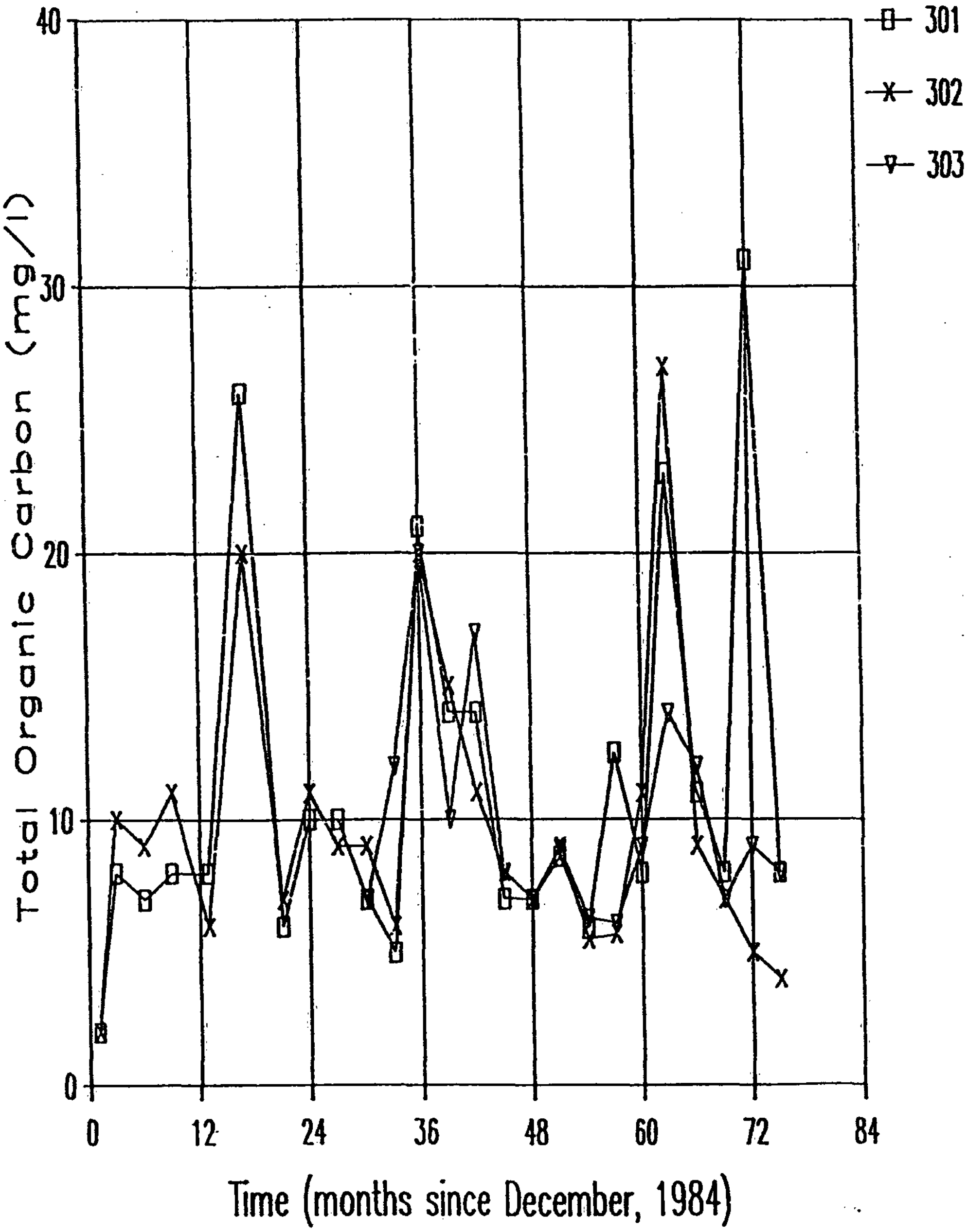

FIGURE 10E
COAL CREEK

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FIGURE 20

TOH IN SURFACE WATER

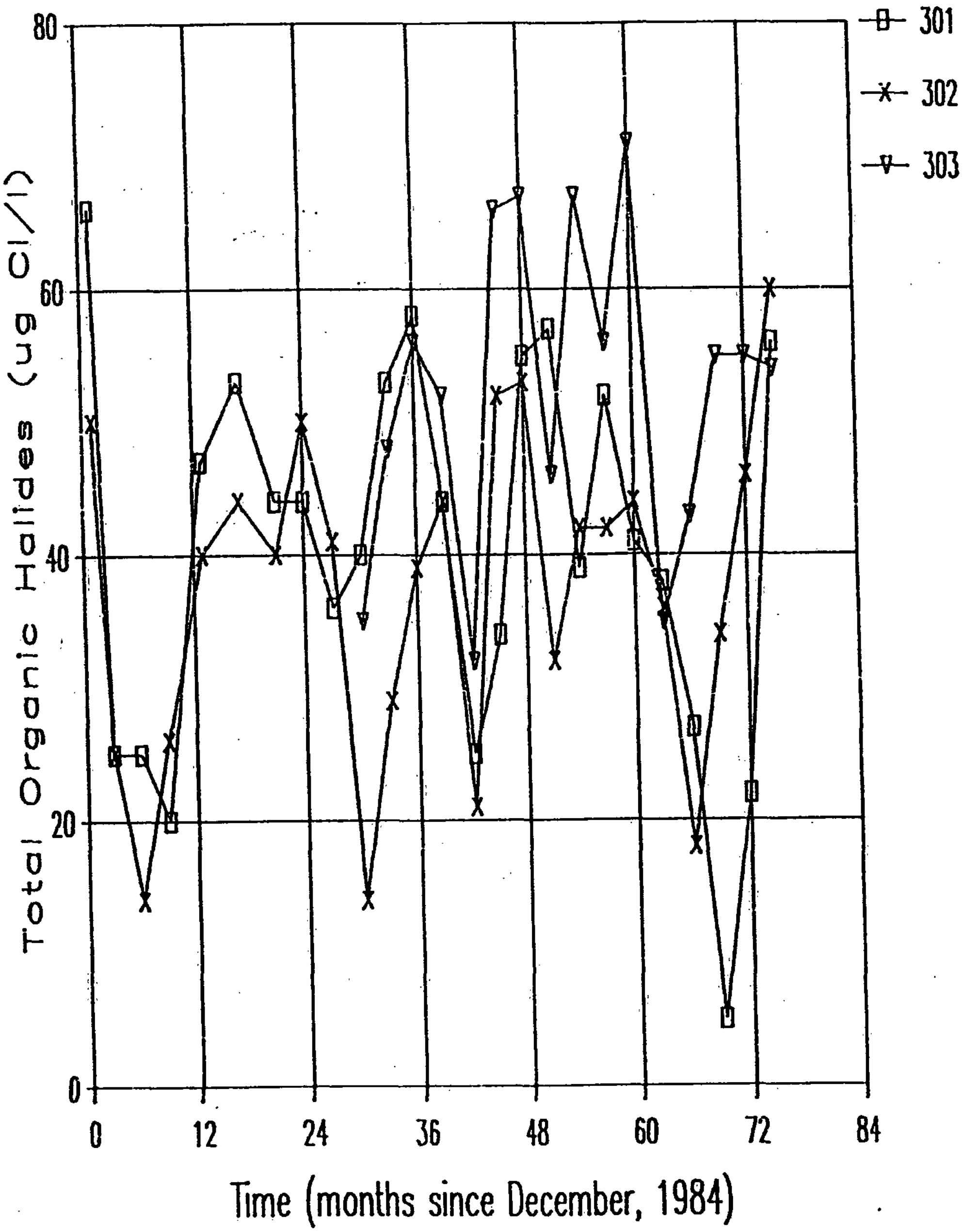

FIGURE 10F
COAL CREEK

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